



ADAPTATION FUND

AFB/PPRC.9/6
8 June 2012

Adaptation Fund Board
Project and Programme Review Committee
Ninth Meeting
Bonn, Germany, 26-27 June 2012

PROPOSAL FOR PERU

I. Background

1. The Operational Policies and Guidelines for Parties to Access Resources from the Adaptation Fund, adopted by the Adaptation Fund Board, state in paragraph 41 that regular adaptation project and programme proposals, i.e. those that request funding exceeding US\$ 1 million, would undergo either a one-step, or a two-step approval process. In case of the one-step process, the proponent would directly submit a fully-developed project proposal. In the two-step process, the proponent would first submit a brief project concept, which would be reviewed by the Project and Programme Review Committee (PPRC) and would have to receive the approval by the Board. In the second step, the fully-developed project/programme document would be reviewed by the PPRC, and would finally require Board's approval.

2. The Templates Approved by the Adaptation Fund Board (Operational Policies and Guidelines for Parties to Access Resources from the Adaptation Fund, Annex 3) do not include a separate template for project and programme concepts but provide that these are to be submitted using the project and programme proposal template. The section on Adaptation Fund Project Review Criteria states:

For regular projects using the two-step approval process, only the first four criteria will be applied when reviewing the 1st step for regular project concept. In addition, the information provided in the 1st step approval process with respect to the review criteria for the regular project concept could be less detailed than the information in the request for approval template submitted at the 2nd step approval process. Furthermore, a final project document is required for regular projects for the 2nd step approval, in addition to the approval template.

3. The first four criteria mentioned above are:

1. Country Eligibility,
2. Project Eligibility,
3. Resource Availability, and
4. Eligibility of NIE/MIE.

4. The fifth criterion, applied when reviewing a fully-developed project document, is:
5. Implementation Arrangements.

5. In its 17th meeting, the Adaptation Fund Board decided (Decision B.17/7) to approve "Instructions for preparing a request for project or programme funding from the Adaptation Fund", contained in the Annex to document AFB/PPRC.8/4, which further outlines applicable review criteria for both concepts and fully-developed proposals.

6. Based on the Adaptation Fund Board Decision B.9/2, the first call for project and programme proposals was issued and an invitation letter to eligible Parties to submit project and programme proposals to the Adaptation Fund was sent out on April 8, 2010.

7. According to the Adaptation Fund Board Decision B.12/10, a project or programme proposal needs to be received by the secretariat not less than nine weeks before a Board meeting, in order to be considered by the Board in that meeting.

8. The following project concept titled "Adaptation to the Impacts of Climate Change on Peru's Coastal Marine Ecosystem and Fisheries" was submitted by the Inter-American Development Bank (IDB), which is a Multilateral Implementing Entity of the Adaptation Fund. This is the second submission of this proposal. It was first submitted as a project concept, using the two-step proposal process, for the 17th Adaptation Fund Board meeting but was withdrawn by the proponent following initial technical review.

9. The current submission was received by the secretariat in time to be considered in the 18th Adaptation Fund Board meeting. The secretariat carried out a technical review of the project concept, assigned it the diary number PER/MIE/Coastal/2011/1, and filled in a review sheet.

10. In accordance with a request to the secretariat made by the Adaptation Fund Board in its 10th meeting, the secretariat shared this review sheet with the IDB, and offered it the opportunity of providing responses before the review sheet was sent to the Project and Programme Committee of the Adaptation Fund.

11. The secretariat is submitting to the Project and Programme Review Committee the summary and, pursuant to decision B.17/15, the final technical review of the project, both prepared by the secretariat, along with the final submission of the proposal in the following section.

II. Project Summary

Peru – Adaptation to the Impacts of Climate Change on Peru’s Coastal Marine Ecosystem and Fisheries

Implementing Entity: IDB

Project/Programme Execution Cost: USD 555,750

Project/Programme Total Cost: USD 6,405,750

Implementing Fee: USD 544,489

Finance Requested: USD 6,950,239

Project/Programme Background and Context:

The overall objective of the proposed project is to support the Government of Peru in reducing the vulnerability of the coastal communities to the impacts of climate change on the coastal marine ecosystems and fishery resources. The proposed adaptation measures include:

- (i) Activities that would contribute to the enhancement of adaptive capacity of artisanal fishing communities along the Peruvian coast, and reduce the vulnerability of coastal ecosystems;
- (ii) Deployment of a modern and efficient surveillance, prediction and information system of climate and environmental key factors at regional and local scales;
- (iii) Development of a knowledge framework to facilitate capacity building at different levels and the dissemination of project’s lessons learned; and
- (iv) Adjustment of the institutional framework (legal, regulatory and organizational) to implement an Ecosystem Approach to Fisheries (EAF) including artisanal fishing.

According to the proposal, compared to classical (non-climatic) good fisheries management, the proposed project considers three aspects directly related to adaptation capacities:

- a) the implementation of a monitoring system that allows the continuous adjustment of the management actions;
- b) a multi-sectoral approach for the governance of the marine coastal domain (fisheries, environment and local authorities); and
- c) a socio-economic approach towards the improvement of the livelihoods of the artisanal fishing communities through ‘win-win’ measures that also benefits the ecosystem resilience.

Component 1: Implementation of interventions in pilot strategic areas for improving the resilience of coastal communities and key marine coastal ecosystems to climate change and variability-induced stress (USD 3,100,000)

This component would help 50% of the existing artisanal fishing fleet in pilot areas that currently use non-selective gears to adopt new sustainable fishing gears and practices, based on the principles of the Ecosystem Approach to Fisheries. At least three artisanal fisheries in the pilot sites would attain Marine Stewardship Council certification, and see tangible improvements in the value of their fish products. Further, at least 2 natural banks would be restored in agreement with local communities and supplying larvae for extensive aquaculture, under an effective ecosystem management plan. At least one area for extensive aquaculture would be implemented with a concession / co-management agreement and clear financial viability and effective ecosystem management, and at least one another area would be established to carry out extensive aquaculture for new species of culture potential, given technological development and risk assessment studies. At least 2 eco-tourism enterprises would be created with

demonstrable income above baseline, following a marine tourism plan for the pilot area. Finally, at least 2,000 ha would be established as “no take” zones in the marine protected areas and other 1,000 ha in the 5 mile wide coastal zone, following a local science-based ecosystem management plan.

Component 2: Deployment of a modern and efficient environment surveillance and prediction system in the marine-coastal ecosystems at regional and local scales supporting fisheries adaptive management under the EAF principles (USD 1,900,000)

This component would establish two operating Oceanographic monitoring systems consisting of: a) 5 gliders (and accessory calibration devices) to report onshore-offshore oceanographic conditions at the two Pilot Areas (PAs); b) at least 6 deployed temperature and conductivity data loggers per PAs, complemented by a bio-environmental monitoring program of ecosystem health indicators set in bays, capes, islands or intervention areas for natural banks or aquaculture activities; c) strengthened IMARPE/local capabilities to support, operate the monitoring system and ensure data quality from near-shore monitoring points. At least two marine coastal meteorological stations located on capes or islands (one per PSA and nearby zones) would be equipped to report in real time on weather conditions, including coastal winds velocities and directions complementing existing information generated by the meteorological climate monitoring stations network. An operational interface would be established for data sharing with other environmental or climatic agencies in the country, together with improved computing facilities for local circulation models outputs, biochemical fields and habitat distribution for key species, as forced by climatic changes of boundary oceanographic conditions. At least 4 baseline assessments oriented to natural banks and aquaculture potential for native species would be conducted at both pilot areas.

Component 3: Capacity building and knowledge management system for implementing the EBA and the EAF, and for the dissemination of project’s lessons learned, targeting government officials, academia, stakeholders and local communities (USD 600,000)

As a result of this component, at least 70% of the artisanal fishing associations would be formally recognized by law and all the artisanal fishing associations at both pilot sites would be trained for organization management practices, sustainable fishing practices, resource co-management benefits, basic bio-environmental monitoring certification programs and market issues. A project website for the dissemination of the information generated by the surveillance and prediction system (Component 2) would be set up, comprising (a) a continuous, open and user-friendly web information system reporting local weather conditions and early warnings for oceanographic or environmental events as red tides, jellyfish blooming, or anoxia; and (b) news, guidelines, technical material, information on good practices and program’s lessons learnt targeting the fisheries community and including the general public, stakeholders, local communities and academia. At least 5 technical workshops and 3 dissemination workshops would be arranged on monitoring and development of new science-based tools and development of Ecological Risk Assessments (ERA) oriented to IMARPE, decision-makers and academia, and at least 3 workshops would be delivered to technical and managerial staff in the use of science-based tools and ERAs as part of implementing the Ecosystem Approach to Fisheries (EAF). At least 10 student’s theses, supporting technical notes on sustainable management of coastal resources, natural banks and aquaculture, taking into account ecological risks under climate change, as well as vulnerability assessments of coastal communities, would be produced.

Component 4: Management policies, regulations and measures promoting the resiliency of coastal ecosystems and local communities to climate change and variability-induced stress (USD 250,000)

This component would lead into a strengthened fishery management system that addresses climate change impacts, by incorporating bio- and socioeconomic valuation of climate change impacts and scenarios, ecological risk assessment processes, and following the EAF framework. At least 2 coastal areas with economic and ecological zoning plans would be implemented, incorporating areas for sustainable aquaculture, benthic fishing ground areas for co-management, and 'no take zones', developed through an open and transparent participatory process. Regulations (development and approval of management action plans) for establishing no-take zones, areas for managed natural banks, ecotourism, and scientific activities would be passed in at least 2 protected areas.



ADAPTATION FUND BOARD SECRETARIAT TECHNICAL REVIEW OF PROJECT/PROGRAMME PROPOSAL

PROJECT/PROGRAMME CATEGORY: REGULAR PROJECT DOCUMENT

Country/Region:	Peru	
Project Title:	Adaptation to the Impacts of Climate Change on Peru’s Coastal Marine Ecosystem and Fisheries	
AF Project ID:	PER/MIE/Coastal/2011/1	
NIE/MIE Project ID:		Requested Financing from Adaptation Fund (US Dollars): 6,950,239
Regular Project Concept Approval Date:	n/a	Anticipated Submission of final RP document (if applicable): n/a
Reviewer and contact person:	Mikko Ollikainen	Co-reviewer(s): Christian Severin
NIE/MIE Contact Person:	Alfred H. Grunwaldt	

Review Criteria	Questions	Comments on 14 May 2012	Comments on 1 June 2012
Country Eligibility	1. Is the country party to the Kyoto Protocol?	Yes.	
	2. Is the country a developing country particularly vulnerable to the adverse effects of climate change?	Yes.	
Project Eligibility	1. Has the designated government authority for the Adaptation Fund endorsed the project/programme?	Yes.	

	<p>2. Does the project / programme support concrete adaptation actions to assist the country in addressing adaptive capacity to the adverse effects of climate change and build in climate resilience?</p>	<p>Requires clarification. While temperature changes have been recorded in the Humboldt Current over the last decade, partly due to the El Nino effects, it seems that the intense fishing effort has been a key contributing factor to the periodic reductions of the anchoveta fishery, in the marine ecosystems in the HCLME, generating effects along the trophic chain. Up to 2006, the development of the fishing industry extracted a significant percentage of the available anchoveta biomass, which has notably reduced the available biomass for top predators, that include some of the most important species of commercial fish (jack and horse mackerel, hake, bonito, corvina, etc.), which is some of the target species in Demo site Mancora, whereas Anchovies is the main target species for the demonstration site Huacho.</p>	
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		<p>CR1: In the project background and context section, please outline not only climatic challenges but also other anthropogenic problems and barriers in Peru specifically that have contributed to the issues that the project aims to solve. Throughout the proposal, please explain how the planned project interventions have been designed to help adapt to climate change, in the context of those other problems and barriers. Please highlight how the selected activities represent adaptation, as compared to non-climate-related good fisheries management.</p>	<p>CR1: Mostly addressed. Non-climatic problems and barriers have been outlined. The case how the project would represent adaptation has been elaborated at the level of individual components. In further development of the proposal, the proponent should anchor the project more strongly to making the overall fisheries management policies in Peru more adaptive, including not only the artisanal part of the fisheries but also the industrial part (CR2). At the level of individual components, the proposal should reassess and strengthen, wherever possible, the adaptation reasoning, seeking possibility to include more measures that go beyond ecological fisheries management.</p>
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		<p>CR2: In management of the Peruvian marine fisheries, the massive industrial fisheries have a strong impact on the overall stock, and it is unclear how the proposed project would encompass activities in that part of the fisheries. It is also unclear, whether focusing on the artisanal fisheries could have an impact that is sufficiently comprehensive and sustainable on the management of the overall stock. Please clarify and align better with activities targeting the industrial part of the fisheries.</p> <p>Among the proposed outputs, there are both activities that are aimed more clearly at producing visible and tangible results, and ones that are of supportive nature such as capacity building, such as establishing eco-tourism enterprises and supporting academic theses.</p>	<p>CR2: According to the revised proposal, the project outcomes on information management (climate surveillance system, ecological risk assessment) would enable also the industrial fisheries to move towards a more sustainable direction. However, as the industrial fisheries are strongly linked to the artisanal fisheries, the further development of the proposal should ensure that the approach is comprehensive enough. To achieve this, it would be beneficial to address the legal and institutional framework spanning both parts of the fisheries and base the concrete activities on such broader basis, even if the “on-the-ground” concrete adaptation measures would mostly focus on the artisanal fisheries. The proposal should consider, whether it would be beneficial for such more comprehensive approach to include activities that would actively engage the industrial fisheries.</p> <p>In terms of presentation, it might be useful to rearrange the rationale so that the political, legal and institutional considerations would be brought more strongly up front and that the concrete adaptation activities would be based on and supported by them. Further, the proponent should fully align national policies with the transboundary framework that is being developed under the GEF-funded Humboldt Current project.</p>

		CR3: Please justify how the capacity-building and institution-developing activities are directly supportive of the concrete adaptation outputs, and consider omitting ones that are not directly supportive.	CR3: Addressed.
	3. Does the project / programme provide economic, social and environmental benefits, particularly to vulnerable communities, including gender considerations?	<p>Yes, the suggested activities will provide benefits to the two demonstration sites.</p> <p>The activities on establishing no take zones, implementation/roll out of newer selective fishing gear, the reestablishment of the 2 natural banks and the introduction of aquaculture will potentially have a benefit for the local communities.</p> <p>CR4: Please explain how the suggested activities would be able to improve the fisheries of the target species, as the main food source for the larger predators are effected equally by what is happening in the main upwelling of the Humboldt Current, which spreads over an area that expands to a much larger area than the demonstration sites.</p>	CR4: Addressed. Only one of the target sites are within the Humboldt Current. At that site, there are also benthic target species, while the sustainability of anchovy fisheries will be improved. In the other site, outside of the Current, top predators do not depend on anchovy.

	<p>4. Is the project / programme cost effective?</p>	<p>The project is proposing to fund activities related to changing the habits of a highly productive fisheries in two demonstration sites to limit their vulnerability to impacts of climate change.</p> <p>It is unclear, however, whether the non-concrete adaptation activities in the project are directly supportive of the concrete adaptation activities: please see the CRs above related to project eligibility criterion 2. Also, more clarification should be provided on the question of potential duplication (CR below).</p> <p>CR5: Project outputs 2.3, 2.4 and 3.3 are all related to information systems, and there seems to be unnecessary duplication. Please streamline as much as possible, and if it is necessary to include such activities under more than one output, clarify the reasons for doing so.</p> <p>CR6: Project outputs 1.4 and 4.3 both target establishment of no-take zones under a management plan. Please streamline as much as possible, and if it is necessary to include such activities under more than one output, clarify the reasons for doing so.</p>	<p>CR5: Addressed. The activities have been regrouped within the project's logical framework.</p> <p>CR6: Addressed. It has been clarified that the two outputs have different focus.</p>
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	5. Is the project / programme consistent with national or sub-national sustainable development strategies, national or sub-national development plans, poverty reduction strategies, national communications and adaptation programs of action and other relevant instruments?	Yes.	
	6. Does the project / programme meet the relevant national technical standards, where applicable?	In the proposal, Section 2.E, compliance with environmental assessment requirements is stated. CR7: Please clarify, which kind of an environmental assessment would be applicable for the introduction of intensive aquaculture, prior to implementation, due to its potential negative impacts to the ecosystem.	CR7: Addressed.

	7. Is there duplication of project / programme with other funding sources?	<p>A number of the substantial outputs, such as establishment of an institutional framework to among others implement an Ecosystem Approach to Fisheries, Establishment of pilot areas under EAF seems to be simultaneous funded by a GEF investment in IW and BD towards the Humboldt Current, in both Peru and Chile.</p> <p>CR8: As it seems that the proposed project would be significantly overlapping with the GEF project in Peru and Chile, please consider revising the focus, to avoid duplication, and build complementarity with it.</p> <p>CR9: Please clarify how Ecosystem Approach to Fisheries (EAF) is different from Ecosystem-Based Management (EBM) of fisheries.</p>	<p>CR8: The revised proposal has clarified the complementarity of the two projects. However, the potential overlap with the GEF funded project is an issue. That would need to be addressed during project development through intensive consultations, to ensure that this project will build upon the results and outcomes of the GEF funded regional Humboldt Current project and that there will not be any overlap between the two projects.</p> <p>CR9: Addressed. It seems that difference between the two concepts is largely semantic, as pertains to the practical activities proposed for the project.</p>
	8. Does the project / programme have a learning and knowledge management component to capture and feedback lessons?	Yes, component 3 includes knowledge management activities.	
	9. Has a consultative process taken place, and has it involved all key stakeholders, and vulnerable groups, including gender considerations?	Yes, a consultative process has taken place and has included a number of the actors, including representatives from the local communities in the demonstration sites.	

	10. Is the requested financing justified on the basis of full cost of adaptation reasoning?	The approach of the project in the context of non-climatic anthropogenic barriers would need to be clarified (CR1).	
	11. Is the project / program aligned with AF's results framework?	Some alignment has been alluded to in the project document. CR10: Please elaborate and include a better overview how the project's proposed activities and outputs would be directly aligned with the AFs results framework.	CR10: Addressed.
	12. Has the sustainability of the project/programme outcomes been taken into account when designing the project?	Sustainability have been discussed. However, it is less clear how the proposed outcomes and outputs have been designed to ensure sustainability. Especially the outputs of Component 2 seem to need a continuous effort and investment to be able to be sustained. CR11: Please explain how the institutional and financial sustainability of the outputs under Component 2 would be ensured.	CR11: Addressed.
	1. Is the requested project / programme funding within the cap of the country?	Yes.	
	2. Is the Implementing Entity Management Fee at or below 8.5 per cent of the total project/programme budget before the fee?	Yes.	
Resource Availability	3. Are the Project/Programme Execution Costs at or below 9.5 per cent of the	Yes.	

	total project/programme budget (including the fee)?		
	4. Is the project/programme submitted through an eligible NIE/MIE that has been accredited by the Board?	Yes.	
	1. Is there adequate arrangement for project / programme management?	(n/a)	
Eligibility of NIE/MIE	2. Are there measures for financial and project/programme risk management?	(n/a)	
Implementation Arrangement	3. Is a budget on the Implementing Entity Management Fee use included?	(n/a)	
	4. Is an explanation and a breakdown of the execution costs included?	(n/a)	
	5. Is a detailed budget including budget notes included?	(n/a)	
	6. Are arrangements for monitoring and evaluation clearly defined, including budgeted M&E plans and sex-disaggregated data, targets and indicators?	(n/a)	

	7. Does the M&E Framework include a break-down of how implementing entity IE fees will be utilized in the supervision of the M&E function?	(n/a)	
	8. Does the project/programme's results framework align with the AF's results framework? Does it include at least one core outcome indicator from the Fund's results framework?	(n/a)	
	9. Is a disbursement schedule with time-bound milestones included?	(n/a)	

Technical Summary	<p>The overall objective of the proposed project is to support the Government of Peru in reducing the vulnerability of the coastal communities to the impacts of climate change on the coastal marine ecosystems and fishery resources. The proposed adaptation measures include:</p> <ul style="list-style-type: none"> (i) Implementation of a group of activities that would contribute to the enhancement of current adaptive capacity of artisanal fishing communities living along the Peruvian coast, and would reduce the vulnerability of coastal ecosystems, while increasing the income and participation of the communities in managing and protecting their natural resource base; (ii) Deployment of a modern and efficient surveillance, prediction and information system of climate and environmental key factors at regional and local scales, supporting fishing, aquaculture and ecotourism activities, as well as fisheries adaptive management based on long-term prevision under climate change scenarios; (iii) Development of a knowledge framework to facilitate capacity building at different levels and the dissemination of project's lessons learned; and (iv) Adjustment of the institutional framework (legal, regulatory and organizational) to facilitate EBA for the coastal marine domain at country-level and to implement an Ecosystem Approach to Fisheries (EAF) including artisanal fishing.
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During initial review of the proposal, the following clarification requests were made:

CR1: In the project background and context section, please outline not only climatic challenges but also other anthropogenic problems and barriers in Peru specifically that have contributed to the issues that the project aims to solve. Throughout the proposal, please explain how the planned project interventions have been designed to help adapt to climate change, in the context of those other problems and barriers. Please highlight how the selected activities represent adaptation, as compared to non-climate-related good fisheries management.

CR2: In management of the Peruvian marine fisheries, the massive industrial fisheries have a strong impact on the overall stock, and it is unclear how the proposed project would encompass activities in that part of the fisheries. It is also unclear, whether focusing on the artisanal fisheries could have an impact that is sufficiently comprehensive and sustainable on the management of the overall stock. Please clarify and align better with activities targeting the industrial part of the fisheries.

CR3: Please justify how the capacity-building and institution-developing activities are directly supportive of the concrete adaptation outputs, and consider omitting ones that are not directly supportive.

CR4: Please explain how the suggested activities would be able to improve the fisheries of the target species, as the main food source for the larger predators are effected equally by what is happening in the main upwelling of the Humboldt Current, which spreads over an area that expands to a much larger area than the demonstration sites.

CR5: Project outputs 2.3, 2.4 and 3.3 are all related to information systems, and there seems to be unnecessary duplication. Please streamline as much as possible, and if it is necessary to include such activities under more than one output, clarify the reasons for doing so.

CR6: Project outputs 1.4 and 4.3 both target establishment of no-take zones under a management plan. Please streamline as much as possible, and if it is necessary to include such activities under more than one output, clarify the reasons for doing so.

CR7: Please clarify, which kind of an environmental assessment would be applicable for the introduction of intensive aquaculture, prior to implementation, due to its potential negative impacts to the ecosystem.

CR8: As it seems that the proposed project would be significantly overlapping with the GEF project in Peru and Chile, please consider revising the focus, to avoid duplication, and build complementarity with it.

CR9: Please clarify how Ecosystem Approach to Fisheries (EAF) is different from Ecosystem-Based Management (EBM) of fisheries.

CR10: Please elaborate and include a better overview how the project's proposed activities and outputs would be directly aligned with the AFs results framework.

CR11: Please explain how the institutional and financial sustainability of the outputs under Component 2 would be ensured.

The proponent submitted a revised proposal, which addressed several of the clarification requests made by the

	<p>initial review. During the further development of the project proposal, the following issues should be addressed:</p> <ul style="list-style-type: none"> - The proponent should ensure that the approach is comprehensive enough and addresses adequately strongly the needs to make the overall fisheries management policies, institutional and legal framework in Peru more adaptive, including not only the artisanal part of the fisheries but also the industrial part, even if the “on-the-ground” concrete adaptation measures would mostly focus on the artisanal fisheries as proposed. In terms of presentation, it might be useful to rearrange the rationale so that the political, legal and institutional considerations would be brought more strongly up front and that the concrete adaptation activities would be based on and supported by them. The proposal should consider, whether it would be beneficial to include activities that would actively engage the industrial fisheries. - At the level of individual components, the proposal should reassess and strengthen, wherever possible, the adaptation reasoning, seeking possibility to include more measures that go beyond ecological fisheries management. - During project development intensive consultations should be held with the GEF-funded Humboldt Current project, to ensure that the two projects are complementary and not overlapping. The activities contributing to development of national policies in the proposed project should be aligned with the transboundary framework that is being developed under the GEF project.
Date:	1 June 2012



ADAPTATION FUND

**REQUEST FOR PROJECT/PROGRAMME FUNDING
FROM ADAPTATION FUND**

The annexed form should be completed and transmitted to the Adaptation Fund Board Secretariat by email or fax.

Please type in the responses using the template provided. The instructions attached to the form provide guidance to filling out the template.

Please note that a project/programme must be fully prepared (i.e., fully appraised for feasibility) when the request is submitted. The final project/programme document resulting from the appraisal process should be attached to this request for funding.

Complete documentation should be sent to

The Adaptation Fund Board Secretariat
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MSN G6-602
Washington, DC. 20433
U.S.A
Fax: +1 (202) 522-3240/5
Email: secretariat@adaptation-fund.org



PROJECT/PROGRAMME PROPOSAL

■ PART I: PROJECT/PROGRAMME INFORMATION

PROJECT/PROGRAMME CATEGORY:	REGULAR PROJECT (CONCEPT)
COUNTRY/IES:	PERU
TITLE OF PROJECT/PROGRAMME:	ADAPTATION TO THE IMPACTS OF CLIMATE CHANGE ON PERU' S COASTAL MARINE ECOSYSTEM AND FISHERIES
TYPE OF IMPLEMENTING ENTITY:	MIE
IMPLEMENTING ENTITY:	INTER-AMERICAN DEVELOPMENT BANK
EXECUTING ENTITY/IES:	MINISTRY OF PRODUCTION
AMOUNT OF FINANCING REQUESTED:	US\$ 6,950,239 (In U.S Dollars Equivalent)

■ PROJECT / PROGRAMME BACKGROUND AND CONTEXT:

Peru sustains the most productive fisheries in the world, yielding nearly 10% of world's fish catch. The main driving factor for this enormous productivity is the physical and chemical characteristics of its coastal upwelling¹ (Chavez et al., 2008), which allow the efficient growth of primary producers, high survival rates of larvae and the efficient trophic transfer to foraging fish and top predators.

Two main marine coastal ecosystems are present off Peru. The Peruvian Coastal Upwelling Ecosystem (PCUE) extends from about 4°30'S to the south all along the coast and about 50-100 km offshore (though its influence can reach further) and is the one that sustains the large fisheries of the Peruvian *anchoveta*. In the north, limited by a narrow and dynamic transition zone, there is the southern tip of the Eastern Pacific Tropical Coastal Ecosystem that extends up to Central America. This ecosystem is characterized by a high marine biodiversity, including large predatory fishes and vertebrates, and is important in terms of artisanal fishing (Hooker, 2009).

The ambit of this proposal consists in these two marine coastal ecosystems: the PCUE and the Tropical Eastern Pacific Coastal Ecosystem. It should be stressed that their marine boundaries are intrinsically dynamic, and they are loosely associated with the extension of the continental shelf and of the upwelling plumes (in the case of the PCUE), about 50 to 100km offshore. Circulation processes in this coastal domain are highly affected by local factors related to the bottom topography, coastal geomorphology and local winds; giving rise to both alongshore and cross-shore mesoscale flows. Due to its dynamics, water depth and proximity to nutrient sources (upwelling or riverine fluxes), the productivity and biodiversity is concentrated in this domain and the key parts of the living cycles of the resources take place here. The offshore

(western) boundaries of these ecosystems interact with the large-scale water masses and current systems, which are maintained by basin-scale ocean-atmosphere interactions and do not depend on local factors. The Humboldt Current system flows off Peru and Chile and is composed by equatorward and poleward surface and subsurface currents that link the tropics with the subtropics¹, extending hundreds of miles away the coast. The onshore (eastern) boundary is the desertic but densely populated coastal fringe, which is a source of several anthropogenic stressors.

The two targeted ecosystems are subject of significant climatic variability that range from the interannual scale (El Niño Southern Oscillation) to the scale of decades or centuries, as palaeoclimatic research has revealed. For example, during strong El Niño events, the warm and nutrient-poor water masses extend along the coast and the overall coastal productivity decrease. Due to thermal stress and scarcity of food sources, anchoveta populations become highly vulnerable and experience high natural mortality. Meanwhile, warm-water, tropical fish species migrate along the coast. The opposite responses occur during the cool La Niña events. Therefore the climatic ecological impacts can have dramatic socio-economic consequences for the fishing industry and for the artisanal fishing communities.

The main uses of the coastal ecosystems services are fishing and aquaculture, and they account for around 3% of Peru's GDP (CSA, 2011; BCRP, 2010). Within the last decade, the contribution of fisheries to the national GDP has increased from 1.5 billion soles to 2.3 billion soles (at currency values of 1994), thus indicating a positive trend. The bulk of sector economic impact is related to *anchoveta* fishing for fishmeal and fish oil industry, in which Peru provides around 35% of the global supply. According to official figures, in 2009 the fishing industry generated almost 30 million US dollars of tax revenues and sold more than 2 billion US dollars as exports².

It is estimated that, between 150,000 and 170,000 people depend directly on the Current's productivity for their daily income. The large-scale industrial fishery dedicated to export production sustains approximately 30,000 employees according to IMARPE. However, it is complemented by artisanal fishery which accounts for an even larger number of employees of which 65,500 are directly engaged in fisheries and 19,200 are employed by fishery-based food processing for direct human consumption, according to the Ministry of Production sources. Artisanal fisheries maintain approximately 10,000 vessels and contribute greatly to the country's food security (Bernales, 2009), by producing between 200,000 and 400,000 tons of catch per annum (Arellano & Swartzman, 2009).

The huge dimension of the fishing yields represents a critical source of stress to the ecosystems and their fisheries resources. In the early 1970's inadequate management led to an extreme vulnerability of the anchovy stock, which collapsed upon the occurrence of a moderate El Niño event in 1972/1973. This crisis, with all subsequent social impacts, has been an important historical lesson. Since then, several regulations and policies have been put into place by the

¹ Note that the 'Humboldt Current Large Marine Ecosystem' (HCLME) consists on the complex system of currents, water masses and biotic components extending as far as 200 to 300 miles, and from Northern Peru to Southern Chile. The criteria for defining this LME include fisheries management for transboundary resources and not only ecological/oceanographic reasons. Upon these criteria the PCUE is embedded within the HCLME. Therefore its scale is beyond the scope of this project

² Besides being processed to fish meal and fish oil, the use of anchoveta for direct human consumption has been promoted by the Peruvian government in recent years and thus become increasingly important.

Government of Peru (GoP) to improve the management and prevent the overexploitation of the anchoveta³. These include regulations to freeze the fishing fleet (which has an overcapacity related to the stock size), and random inspections of physical storage capacity to monitor compliance with capacity limitations. In June 2008, GoP adopted Legislative Decree No. 1084, which regulates anchoveta fishing quotas by vessel, regulating all anchoveta fishing for indirect human consumption. In December 2008, the government enacted regulations to define the maximum catch limits for anchoveta fishing vessels (industrial fisheries). The quotas system has alleviated the fishing pressure on the main stock and a precautionary policy for the overall quota has allowed a slow recovery of the populations of some top predators, as the guano birds and seals; however the fleet overcapacity still persists and most of other fisheries are not subject to the individual quotas system, so that the resources remain under high risk of overexploitation.

For the artisanal fleet, since 2009 the GoP removed any restriction on fishing anchovy for direct human consumption within the five coastal miles. But since the fleet is composed by purse-seine boats, there are two undesired consequences: on one hand, purse-seine fishing leads to a high incidental catch of other species that are effectively used for human consumption which reduce their availability for other artisanal fishers; and second, the caught specimens do not have the quality standards for the direct human consumption market. Therefore the major part (>90%) of the artisanal purse-seine catches is used for fish meal reduction. While artisanal landings of anchovy are rising considerably along the coast (they equalled 260 000 and 295 000 t in 2010 and 2011, respectively), conflicts among the industrial and artisanal fleets may arise and grow over time.

Land-based activities are another important source of stress on the coastal marine ecosystems. Pollution, coastal development and resource exploitation are major stressors. Currently, many oil platforms are installed onshore the Northern coast, and there are seismic explorations and plans to extend this economic activity by the private sector. Therefore oil/gas exploration and exploitation are emerging threats for the coastal ecosystems. Peru has taken some steps to address these anthropogenic pressures. These include coastal zone management initiatives and establishment of sectoral regulatory and normative frameworks and mechanisms to reduce the impact of land-based activities on coastal and marine assets. However these efforts are largely focused within single sectors, have limited scope, and are inadequate to address this highly complex, variable and linked ecosystems.

Climate change is affecting the heat content, thermal stratification, acidity and oxygen content in the oceans so that it becomes an additional stressor for the global marine ecosystems. Current oceanographic trends for the last 30-40 years indicate a strengthening of coastal upwelling and related primary productivity near shore Central to Southern Peru, whereas warming and increasing thermal stratification off Northern Peru and the rest of the coast (Gutiérrez et al., 2011). These trends should lead to changes in the distribution, life-cycle and catch potential of marine resources. For example, the species may adjust their distribution towards the best range of temperature, food availability, wind-driven turbulence and oxygenation, leading in some cases to the expansion or to the contraction of their range of distribution (Cheung et al., 2009, 2010). The anchoveta may be benefited by an expansion of its habitat at first, though later, increasing wind-driven turbulence might increase the natural mortality of fish larvae. On the other hand, warm-water species as tuna might expand its distribution southward and become more available for fishing. Nevertheless the overall fish potential in the Peruvian coastal ecosystems will ultimately depend on the fate of the primary productivity (e.g. carrying capacity).

³ Anchovetas (or Peruvian anchovies – *Engraulis ringens*) represent 60-80-% of the total marine fish catch, 99% of which is converted to fish meal for consumption by cultured fish and livestock.

Since global models predict an increase of thermal stratification and weakening of the trade winds that control the potential productivity in the Eastern Pacific (Vecchi & Soden, 2007; Echevin et al., 2011), a decrease in the Peruvian fishing yields is expected in the long-term.

Summarizing, even that there is still uncertainty about the near-future evolution of upwelling and water mass distributions, there is no doubt that these would impact significantly on habitat distribution and carrying capacities of the fishery resources. These impacts would add additional stress to the coastal ecosystems which are already threatened by the non-climatic factors, some of them mentioned above:

- i) Overexploitation and inappropriate fishing techniques, particularly in the coastal, onshore resources;
- ii) Pollution, mainly associated with a lack of or inadequate treatment of sewage, waste waters and solid waste generated by coastal cities⁴ (SUNASS, 2008) and industrial activities such as oil and gas production, transport and storage, mining, fish processing and aquaculture, agriculture and several other manufacturing activities (Sánchez Rivas G. et al., 2010);
- iii) Unplanned coastal land use change⁵; and
- iv) Sea-based activities related to oil and gas exploration and production, and sea-based pollution related with maritime transport, waste disposal by fishing units, etc.

As shown in Figure 1 the communities of the Peruvian coast, including 15% of the nation's urban population, are highly vulnerable to eventual changes in the fish production due to

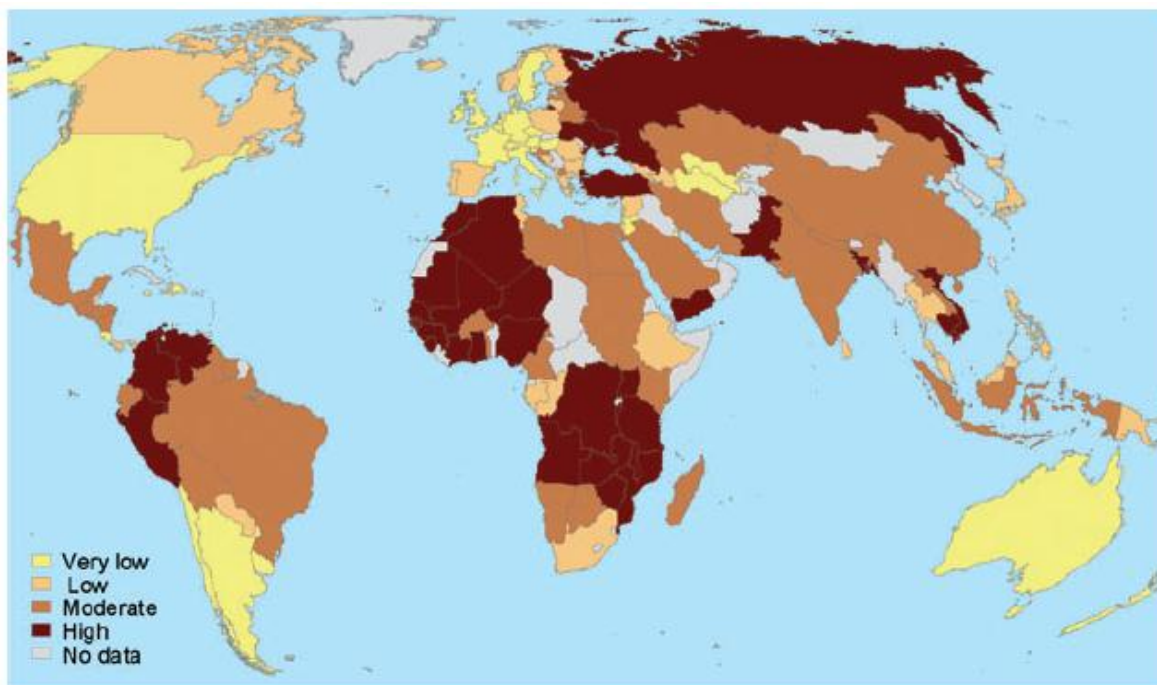


Figure 1: Vulnerability of national economies to potential climate change impacts on fisheries under IPCC scenario B2 (Allison et al., 2009)

⁴ At least 70% of domestic wastewater from coastal cities goes to the sea without any previous treatment.

⁵ According to the 2007 census, around 14 million inhabitants, 50% of the country population, live in the 34 coastal provinces of the country.

variables such as climate exposure, sensitivity or fisheries dependence and limited adaptive capacity (Allison, E.H. et al., 2009), thus a reduction of the fisheries' productivity would mean a significant drawback in Peru's economy.

The main challenge thus consists in increasing the resilience of the coastal marine ecosystems and of the coastal communities (particularly the artisanal fishing communities) to climate change impacts (e.g. the Ecosystem Based Adaptation, EBA; CBD, 2009).

Therefore the **main beneficiaries** of this proposal are the artisanal fishing communities, whose livelihoods largely depends on the status of the marine coastal ecosystems, which are already subject to a number of non-climatic threats. The project will carry out adaptive 'win-win' measures to improve the resiliency to climate change of both the ecosystems and of the artisanal fishing communities.

The approach of the proposal is to focus the adaptation measures in two pilot areas, one associated to the southern tip of the Tropical Eastern Pacific Coastal Ecosystem, and the other one, a typical representative of the PCUE. In the selected pilot areas the project will create the regulatory framework for the local fisheries community to play a major role in the management of a given "area of exploitation"; strengthen the community to execute its role as main partners in the management; develop a group of productive activities to enhance the income of the associated fishing community, also providing alternative livelihoods; implement a monitoring and applied research component seeking to develop an early-warning information platform and the know-how required for the sustainable exploitation of the selected environmental services; and develop the regulation, policy and administrative capacity to create the enabling environment for the fishing communities effective management of the selected "area of exploitation". The ultimate purpose of the proposal is that these adaptive measures at local level can be upscaled or replicated to other zones of the coastal domain, combining governance, capacity building and interventions sponsored by the government and the private sector.

Activities that include an improved ecosystem management by those with vested interests in its long-term sustainability, allowance of sustainable fishing quotas, adoption of ecological friendly fishing and harvesting practices, and the promotion of the sustainable use of other ecosystem services with minimal impact in the ecosystem health, should improve the livelihoods of the fisher communities, thus reducing their vulnerability to climate change and variability induced stress. This requires an improved climatic and environmental surveillance and enhanced capabilities on modelling to enable the diagnosis and constant monitoring as well as the prediction of likely changes of the ocean currents and the resulting development of the fish stocks due to climate change. In addition, a comprehensive regulatory framework must be put in place regulating fishing quota and techniques in accordance with the information provided by the modelling and monitoring system. The absence of such a rigorous regulatory framework has in the past limited the adoption of sustainable fishing systems, which is particularly reflected in the status of artisanal fishery resources.

The proposal recognizes the presence of other land based ecosystem stressors, such as pollution, land based activities with disturbing impacts (mega-ports), as well as coastal marine exploration and exploitation of gas and oil fields. Although these activities are beyond the scope of the project, the proposal understands their strategic importance. The approach selected is to support and strengthen the efforts of the GOP in developing and implementing land use plans in coastal areas. Working with the municipalities and their agencies responsible for developing territorial plans, under the general guidance and coordination of the Ministry of Environment, the

project will support developing the processes required to formulate and adopt local territorial plans. This effort also includes developing management plans for MPA as needed to secure no-take zones.

The proposed project attempts to put in place the required technical systems as well as enhance the necessary regulatory adjustments at national and at local levels in order to support the coastal communities and Peru's economy to adapt to the likely impacts of climate change on the productivity of their marine and coastal ecosystems. It will give particular emphasis on artisanal fishery. This emphasis of course does not ignore nor seek to diminish the role that industrial fishing plays in the Peruvian economy and its impacts to fish stocks. On the contrary, the proposed project seeks to complement on-going efforts of national authorities to regulate industrial fishing. It will complement climatic monitoring and will build regulations and capacities to implement the Ecosystem Approach to Fisheries for coastal marine ecosystems adding to ongoing efforts comprising mostly the Humboldt Current Ecosystem. As it will be explained along the proposal, the project will contribute to implement sustainable fishing practices, targeting fish products for direct human consumption with a better income for the fishermen, support co-management of benthic fishing ground areas and natural banks, and incentive extensive aquaculture and ecotourism as alternate economic activities. All together, these measures, and the creation and/expansion of Marine Protected Area and no-take zones, will contribute to lower the fishing pressure over the stocks and improve the fisheries sustainability and their resiliency to climate change.

PROJECT OBJECTIVES:

The overall objective of the project is to support the Government of Peru in reducing the vulnerability of the coastal communities to the impacts of climate change on the coastal marine ecosystems and fishery resources. This will require the implementation of a group of adaptation measures that include:

- (i) Implementation of a group of activities that contribute to the enhancement of current adaptive capacity of artisanal fishing communities living along the Peruvian coast, and reduce the vulnerability of coastal ecosystems, while increasing the income and participation of the communities in managing and protecting their natural resource base.
- (ii) Deployment of a modern and efficient surveillance, prediction and information system of climate and environmental key factors at regional and local scales, supporting fishing, aquaculture and ecotourism activities, as well as fisheries adaptive management based on long-term prevision under climate change scenarios.
- (iii) Development of a knowledge framework to facilitate capacity building at different levels and the dissemination of project's lessons learned;
- (iv) Adjustment of the institutional framework (legal, regulatory and organizational) to facilitate EBA for the coastal marine domain at country-level and to implement an Ecosystem Approach to Fisheries (EAF) including artisanal fishing.

As compared to classical (non-climatic) good fisheries management, the proposed project considers three aspects directly related to adaptation capacities: a) the implementation of a monitoring system that allows the continuous adjustment of the management actions; b) a multi-sectoral approach for the governance of the marine coastal domain (fisheries, environment and local authorities); and c) a socio-economic approach towards the improvement of the

livelihoods of the artisanal fishing communities through 'win-win' measures that also benefits the ecosystem resilience.

Specifically, the presented group of adaptation measures is built upon the following key foundational concepts:

➤ **An ecosystem stressed by overfishing is more likely to collapse when subjected to climate change.** Policies to prevent overfishing and ensure the sustainable use of fish stocks help build ecosystem resilience to climate change (*WorldFish Center 2007*). In this sense **component 4** builds on current national efforts to prevent overfishing caused by industrial fleets and seeks the development of sustainable management of the coastal ecosystems, following the EAF and the transfer of management rights to local artisanal fishing communities but limit open access to the resources. The concrete adaptation activities for extensive aquaculture, co-management of benthic fishing ground areas and the implementation of 'no take' zones are all aligned with this philosophy.

Moreover, in terms of climate change adaptation and building resilient systems (i.e. including reducing exposure and increasing adaptive capacities), the application of the EAF would be an important contribution to maintaining biodiversity, preserving the resilience of human and aquatic systems to change, and improving our capacity to anticipate and adapt to inevitable climate induced changes in aquatic ecosystems and the related fisheries production systems.

➤ **A sustainable dynamic surveillance, prediction and information system to fill the existing gap of reliable climatic and non-climatic data is key for an effective adaptation process of marine and coastal ecosystems.** Based on the premise that adaptation is a non-static continuous process, requiring a multi-sectorial approach, the use, visualization and proper interpretation of data for decision making and the elaboration of natural resources management plans becomes a structural pillar of any EBA strategy, in which coastal communities are directly involved. In this context, **component 2** is aimed at designing a modern system of climatic and oceanographic surveillance, forecasting and long-term prediction, including biological, physical and chemical variables, which will be used for early warning and for supporting ecotourism, aquaculture and fishing activities as well as adaptive fishery management.

➤ **A key to successful adaptation for vulnerable communities is promoting the diversification of livelihoods.** Livelihood diversity helps ensure that, if one economic option temporarily closes, people can resort to other options for making a living. Poverty reduction strategies that help diversify livelihoods and improve poor people's access to natural resources also help build adaptive capacity for climate change (*FAO, Fisheries report No. 870*). In this context **component 1** encompasses a group of activities, selected by the communities themselves, aimed at diversifying current livelihoods of coastal communities contributing to reduce their vulnerability to climate change impacts.

➤ **An effective and efficient adaptation process should be implemented in parallel at different levels, involving clear customized strategies to disseminate lessons learned and building capacities for replication and up-scaling successful measures.** Although resource-dependent communities have adapted to change throughout history, projected climate change poses multiple additional risks to fishery dependent communities that might limit the effectiveness of past adaptive strategies.

Adaptation strategies will require to be context- and location-specific and to consider impacts both short-term (e.g. increased frequency of severe events) and long-term (e.g. reduced productivity of aquatic ecosystems). All three levels of adaptation (community, national and regional) will clearly require and benefit from stronger capacity building, through awareness raising on climate change impacts on fisheries and aquaculture, promotion of general education, and targeted initiatives in and outside the sector. (*FAO, Fisheries report No. 870*). In this context **component 3** is designed so that lessons learned from the project could be disseminated to the general public and project stakeholders in an efficient manner. Similarly, capacity building activities on the use of new science-based tools for decision making and ecological risk assessments will be developed to government officials, academia and stakeholders.

The adaptation interventions will focus both on the national level and on two specific pilot areas, one in the southern tip of the Tropical Eastern Pacific Coastal Ecosystem-in the northerly Piura Region and the other one representative of the PCUE located in the central coast. In accordance to the main fishing towns in both areas (north and center), pilot sites will be named Máncora and Huacho, respectively.

■ **PROJECT / PROGRAMME COMPONENTS AND FINANCING:**

PROJECT COMPONENTS	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	AMOUNT (US\$)
<p>Component 1. Implementation of interventions in pilot strategic areas for improving the resilience of coastal communities and key marine coastal ecosystems to climate change and variability-induced stress</p>	<p>1.1. A target of 50% of the existing artisanal fishing fleet in pilot areas that currently use non-selective gears, adopting new sustainable fishing gears and practices, based on the principles of the Ecosystem Approach to Fisheries. At least three artisanal fisheries in the pilot sites attaining MSC certification, and tangible improvements in the value of the ir fish products.</p> <p>1.2. At least 2 natural banks restored in agreement with local communities and supplying larvae for extensive aquaculture, under an effective ecosystem management plan.</p> <p>1.3. At least one area for extensive aquaculture under concession / co-management agreement with clear financial viability and effective ecosystem management under implementation; at least one another area established to carry out extensive aquaculture for new species of culture potential, given technological development and risk assessment studies.</p> <p>1.3 At least 2 eco-tourism enterprises created with demonstrable income above base line, following a marine tourism plan for the pilot area.</p> <p>1.4 At least 2,000 ha will be established as “no take” zones in the marine protected areas and other 1,000 ha in the 5 mile wide coastal zone, following a local science-based ecosystem management plan.</p>	<p>Increased resilience and reduced vulnerability of targeted marine-coastal ecosystems to observed and anticipated effects of climate change and variability-induced stress.</p> <p>Improved adaptive capacity of participating local communities through the diversification and strengthening of their livelihoods and sources of income, in face of climate change induced modifications of biomass and distribution of fish resources.</p>	<p>3,100,000</p>

<p>Component 2. Deployment of a modern and efficient environment surveillance and prediction system in the marine-coastal ecosystems at regional and local scales supporting fisheries adaptive management under the EAF principles</p>	<p>2.1 Two operating Oceanographic monitoring systems consisting of: a) 5 gliders (and accessory calibration devices) to report onshore-offshore oceanographic conditions at the two Pilot Areas (PAs); b) at least 6 deployed temperature and conductivity data loggers per PAs, complemented by a bio-environmental monitoring program of ecosystem health indicators set in bays, capes, islands or intervention areas for natural banks or aquaculture activities; c) strengthened IMARPE/local capabilities to support, operate the monitoring system and ensure data quality from nearshore monitoring points.</p> <p>2.2. At least two marine coastal meteorological stations located on capes or islands (one per PSA and nearby zones) reporting weather conditions at real-time, and coastal winds velocities and directions complementing existing information generated by the meteorological stations network of climate monitoring.</p> <p>2.3. An operational interface for data sharing with other environmental or climatic agencies in the country, and improved computing facilities for output of models of local circulation, biochemical fields and habitat distribution for key species, as forced by climatic changes of boundary oceanographic conditions.</p> <p>2.4. At least 4 baseline assessments oriented to natural banks and aquaculture potential for native species at both pilot areas.</p>	<p>Increased response capacity of the government at the national and sub-national level to address climate change induced physical and ecological stresses on the marine coastal environment, ecosystem services and resources availability</p> <p>Strengthened capacity of local communities to manage natural banks and know-how for sustainable aquaculture of selected species taking into consideration changes in key climatic and oceanographic indicators.</p>	<p>1,900,000</p>
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<p>Component 3. Capacity building and knowledge management system for implementing the EBA and the EAF, and for the dissemination of project's lessons learned, targeting government officials, academia, stakeholders and local communities</p>	<p>3.1. At least 70% of the artisanal fishing associations formally recognized by law and all the artisanal fishing associations at both pilot sites trained for organization management practices, sustainable fishing practices, resource co-management benefits, basic bio-environmental monitoring certification programs and market issues.</p> <p>3.2. Design and operation of a project website for the dissemination of the information generated by the surveillance and prediction system (Component 2), comprising (a) a continuous, opened and friendly web information system reporting local weather conditions and early warnings for oceanographic or environmental events as red tides, jellyfish blooming, or anoxia; and (b) news, guidelines, technical material, information on good practices and program's lessons learnt targeting the fisheries community and including the general public, stakeholders, local communities and academia.</p> <p>3.3. Delivery of no less than 5 technical workshops and 3 dissemination workshops on monitoring and development of new science-based tools and development of Ecological Risk Assessments (ERA) oriented to IMARPE, decision-makers and academia. Also at least 3 workshops delivered to technical and managerial staff in the use of science-based tools and ERAs as part of implementing the Ecosystem Approach to Fisheries (EAF).</p> <p>3.4. At least 10 student's theses, supporting technical notes on sustainable management of coastal resources, natural banks and aquaculture, taking into account ecological risks under climate change, as well as vulnerability assessments of coastal communities.</p>	<p>Strengthened institutional capacity to assess the extension and magnitude of climate change impacts on fisheries and effective actions to cope with these changes, limiting climate-induced losses of local community incomes.</p> <p>Lessons from pilot sustainable adaptation measures incorporated into the national development strategy and used to program scaled-up EAF governmental programs.</p> <p>Strengthened awareness and ownership of adaptation and climate risk reduction processes of impacted communities in the project targeted areas</p> <p>Improved policies and regulations that promote and enforce resilient measures.</p>	<p>600,000</p>
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<p>Component 4. Management policies, regulations and measures promoting the resiliency of coastal ecosystems and local communities to climate change and variability-induced stress.</p>	<p>4.1 Strengthened fishery management system addressing climate change impacts, by incorporating bio- and socioeconomic valuation of climate change impacts and scenarios, ecological risk assessment processes, and following the EAF framework.</p> <p>4.2. At least 2 coastal areas with economic and ecological zonification plans under implementation, incorporating areas for sustainable aquaculture, benthic fishing ground areas for co-management, and 'no take zones', developed through an open and transparent participatory process.</p> <p>4.3. Regulations (development and approval of management action plans) for establishing no-take zones, areas for managed natural banks, ecotourism, and scientific activities in at least 2 protected areas.</p>	<p>Improved governance, policies and regulation at national (sector) and local levels to enhance the sustainable and resilient use of coastal marine resources.</p>	<p>250,000</p>
<p>Total Project Cost TPC</p>			<p>5,850,000</p>
<p>Project Execution Cost (management and coordination) PEC</p>			<p>9.5% of TPC (555,750)</p>
<p>Project Cycle Management Fee charged by the Implementing Entity⁶</p>			<p>8.5% of TPC+PEC (544,489)</p>
<p>Amount of Financing Requested</p>			<p>6,950,239</p>

⁶ On the request of the Government of Peru, the project will be implemented by the IDB using the MIE modality. IDB is able to provide the following implementation services through its country office, regional and headquarters networks: project identification, formulation, and appraisal; determination of execution modality and local capacity assessment of the national executing entity; briefing and de-briefing of project staff; oversight and monitoring of AF funds, including participation in project reviews; receipt, allocation and reporting to the AF Board of financial resources; thematic and technical capacity building and backstopping; support with knowledge transfer; policy advisory services; technical and quality assurance; and troubleshooting assistance to the national project staff.

■ PROJECTED CALENDAR:

Indicate the dates of the following milestones for the proposed project/programme

MILESTONES	EXPECTED DATES
Submission of Concept to AF	April 2012
Approval of the Concept by the AF Board	June 2012
Submission to AF of a Full Project Proposal	September 2012
Start of Project/Programme Implementation	March 2013
Mid-term Review (if planned)	March 2015
Project/Programme Closing	September 2017
Terminal Evaluation	October 2017

■ PART II: PROJECT/ PROGRAMME JUSTIFICATION

- A. Describe the project/ programme components, particularly focusing on the concrete adaptation activities of the project, and how these activities contribute to climate resilience. For the case of a programme, show how the combination of individual projects will contribute to the overall increase in resilience.

A.1 INTRODUCTION TO PROJECT COMPONENTS

The proposed adaptation project consists of four components, namely: 1) the implementation of interventions in pilot strategic areas for improving the resilience of coastal communities and key marine coastal ecosystems to climate change and variability-induced stress; 2) deployment of a modern and efficient surveillance, prediction and information system of climate and environmental key factors at regional and local scales, supporting fishing, aquaculture and ecotourism activities, as well as fisheries adaptive management based on long-term prevision under climate change scenarios; 3) capacity building for implementing the EAF as a means for dealing with the consequences of climate change and to disseminate and inform project's lessons, targeting government officials, academia, stakeholders and local communities and 4) management policies, regulations and measures promoting the resiliency of coastal ecosystems and local communities to climate change and variability-induced stress.

These adaptation actions will be carried out both at the national and sub-national levels involving a variety of actors including local fishermen's associations, local development agencies and other governmental agencies. Interventions in the first component are centered in two pilot areas, namely Mancora and Huacho, while the other three will have in addition a national area of action, necessary for the success of this project.

The adaptation approach which will be adopted for the proposed project responds to the recommendations presented by international experts from developed and developing countries during the workshop "*The Economics of Adapting Fisheries to Climate Change*"

organized by the OECD in Busan, Korea in 2010 to address challenges of climate change for fisheries and to provide practical insights to policy makers.

It is expected that climate change will impact on the biodiversity, habitat quality, carrying capacities and life cycles of marine ecosystems and organisms, as well as on socio-economic services, such as fish catch potential, fishing efforts and fishermen incomes, increasing the vulnerability of the ecosystem and the human local communities. Other anthropic stressors, as by-catch, discard practices and pollution can further amplify climate change impacts through effects on ecological processes, as spawning rates and distribution of nursery grounds⁷. Consequences on catch and fishing effort also imply changes in the mean trophic levels of the fishery community (Pauly et al., 1998) (Figure 3).

A combination of replicable actions at local scale (targetting affected communities) and national policies (need to be developed for a long-term and effective enabling environment) are both required to ensure a successful adaptation process. Benefits from these adaptation measures could be distributed along the short to the long-term. Of special interest are those contributing to the welfare of local communities, preserve or restore key ecosystems while bringing immediate and concrete development co-benefits. Adaptation measures bringing long-term benefits, such as marine coastal zonification or implementation of marine protected areas, contribute to create an enabling environment for the successful execution of adaptation measures and to the sustainability of the results. The proposed project is designed to follow this strategy, by articulating four types of adaptation measures (as mentioned before) benefiting two pilot areas in the short- and long-term. This will also bring benefits nationwide, by strengthening existing governmental capacity to learn from the pilots and direct apply lessons learned to decision making, enhancing climate change adaptation.

Specifically, the group of short to long-term adaptation measures proposed by the project are aimed to helping local communities living in the coastal areas of Huacho and Mancora to cope with climate change impacts and threats that include: (i) vulnerable resource stocks and fisheries productivity, (ii) increased variability and uncertainty of fishery yields, (iii) changes in distribution of fisheries, (iv) increased vulnerability of communities and infrastructure to climatic extremes (precipitation, floods), (v) trade and market shocks (Table 1).

Climate change impacts and threats of	Adaptation measures at target pilot areas
Vulnerable resource stocks and fisheries productivity	Reduction of fishing pressure through improved fishing selectivity and implementation of the Ecosystem Approach to Fisheries (EAF) Implementation of 'no-take' zones for the restoration of natural banks in marine protected areas Access to high value markets (certification, higher quality of products with new gears) Improved value of fish and other resource products for human consumption, through fishery certification and access to markets

⁷ The economics of adapting fisheries to climate change, OECD 2010

Increased variability and uncertainty of fishery yields	Diversification of economic activities (ecotourism and aquaculture) Implementation of ecosystem-approach to fisheries (EAF)
Changes in distribution of fisheries	Bio- oceanographic monitoring and ecological modelling to predict changes in resource availability Ecological risk assessments of key species for integrated adaptive management Precautionary management based on ecological risk assessments and model predictions
Increased vulnerability of communities and infrastructure to climatic extremes (precipitation, floods) Trade and market shocks	Improved climatic and oceanographic surveillance and deployment of early warning system Use of scenarios of climate change impacts for ecosystem based adaptation, coastal-marine zonification and infrastructure planning Improved self-organization of local fish communities to make use of science based information, market opportunities and diversification of economic activities

Table 1. Climate change impacts and adaptation measures to be applied in the project (adapted from Daw et al., 2009)

Figure 3 below shows project's components' inter-relations under a climate change impacts framework. Starting from the top of the figure, climate change affects directly the provision of services by the marine-coastal ecosystems in Peru at multiple levels (productivity, distribution, biodiversity, etc.), which will put in danger coastal communities' livelihoods in areas already vulnerable (e.g. with significantly high poverty levels) partly due to other non climatic stressors.

As shown in the figure below, components 2 and 4 tend to share the same "area" of action, that is improving the understanding of climate change impacts on distribution, growth and reproduction of fish-stocks through the deployment of a monitoring system and applied research sub-component seeking to develop long-term scenarios for adaptive planning and also the know-how required for the sustainable exploitation of the selected environmental services; and develop the regulation, policy and administrative capacity to create the enabling environment for the fishing communities effective management of the selected "area of exploitation.

Similarly, components 1 and 3 will be focused on the implementation of a group of site-specific productive activities to enhance the income of the associated fishing community also providing alternative livelihoods and assuring the means to disseminate lessons learned and

strengthening the community to execute its role as main partners in the management of their “area of exploitation”

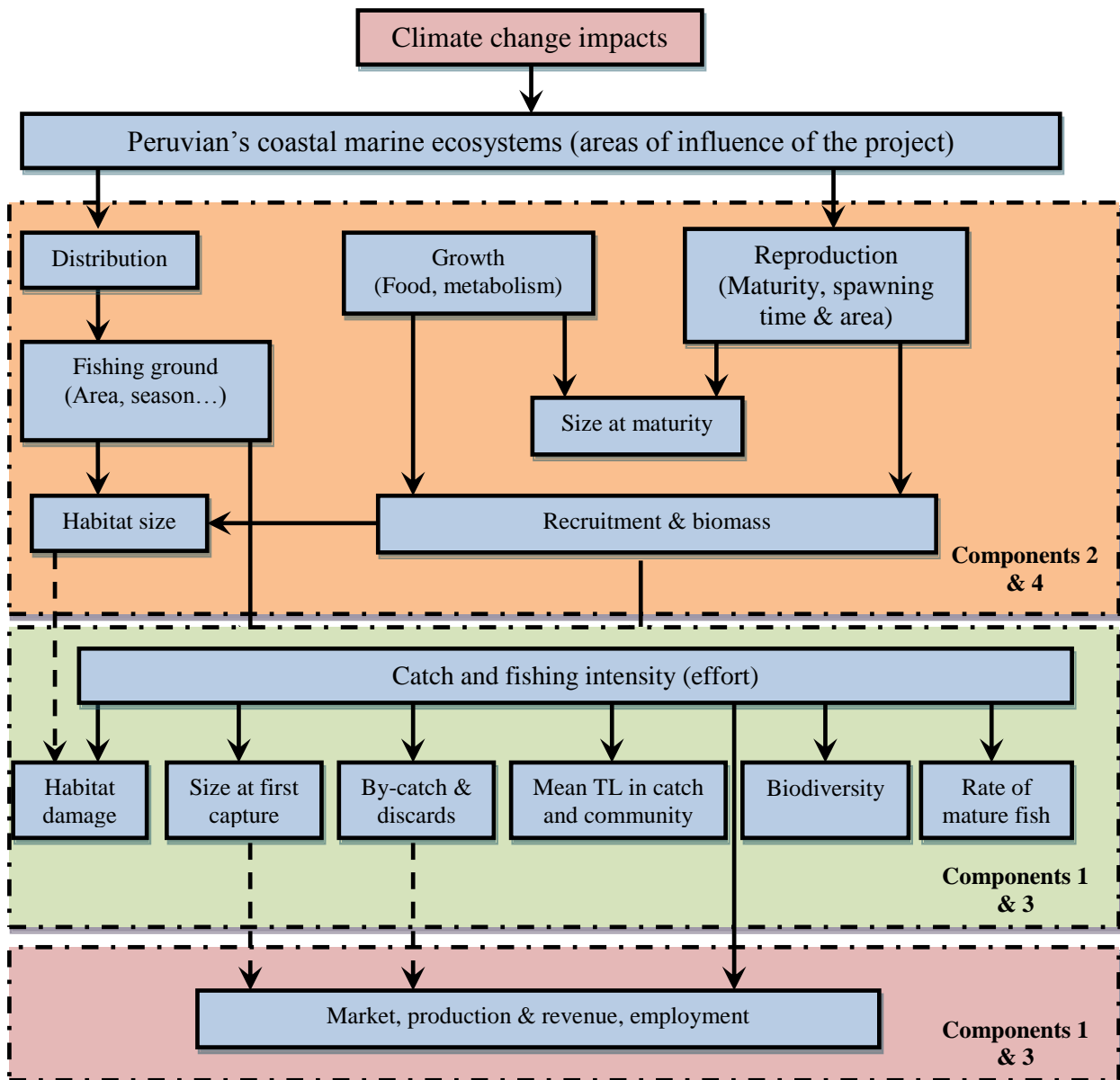


Figure 3. Flowchart indicating climate change impacts in marine ecosystems and areas of influence for the project. Source: adapted from Grafton (2010).

As the Peruvian coast is a region of exceptionally high and sustained upwelling, it likely sustains a larger artisanal fishery than less productive coastal areas in other countries. Also, though the artisanal fishery has exclusive fishing rights to the 5 nautical miles of the coast they are not restricted to this area and often capture fish as far offshore as 200 nautical miles. They therefore contribute to existing environmental and economic pressures on the

Peru's coastal marine ecosystem. Studies carried out by IMARPE between 1996 and 2006 confirmed that natural phenomena like El Niño events had a significant effect on abundance, range and availability of the dominant species in the artisanal fishery catch. It can therefore be expected that changes in the climate with subsequent impacts on the ecosystems' capacity will put at risk the long-term sustainability of artisanal fishing. Their flexibility in responding to variations in type and location of catch, however, could be an important asset in adapting to future changes.

The artisanal fisheries of Peru produce between 200,000 and 400,000 tons of catch per annum according to the data collected by IMARPE. These catches are important not only in terms of volume but also for its socioeconomic effect, being a source of employment and sustenance for a significant number of Peruvians. Its rate of growth has, however, been slower than other sectors of the economy and the artisanal fisheries sector has not received the needed support to achieve sustainable growth. Nonetheless, the number of fishers has increased 34% in the last 10 years to almost 38,000, while the number of vessels has increased 54% to almost 10,000 (Estrella, 2006).

A.2 DESCRIPTION OF PROJECT COMPONENTS

Component 1. Implementation of interventions in pilot strategic areas for improving the resilience of coastal communities and key marine coastal ecosystems to climate change and variability-induced stress

Selection of Pilot Areas

The Peruvian coast is affected by two main climate and oceanographic systems. The Northern coast is partly under the influence of warm tropical waters and high precipitations on land, whereas the rest of the coast is subject to the cold coastal upwelling waters and arid conditions on the continent. Current trends in coastal SST exhibit significant warming for the Northern coast (<06°S), contrasting with strong cooling from the central coast to the south (Gutiérrez *et al.*, 2011). This behavior is also associated with different trends in productivity and possibly subsurface water oxygenation (Demarcq, 2009; Quipúzcoa *et al.*, accepted).

The selection of pilot sites is the result of a multidisciplinary analysis based on the different types of exposure to climate change impacts and variability, general ecological characteristics of the Peruvian coast, the presence of artisanal fishermen communities and the availability of resources. It was determined that within the existing resource envelope only two sites could be incorporated. It was also decided that one site should be located in the Northern part of the coast at the southern boundary of the Tropical Eastern Pacific Coastal Ecosystem, subjected to the interplay between the warm tropical waters and the northward intrusion of upwelling waters, currently under a warming trend. The second site is representative of the Peruvian Coastal Upwelling Ecosystem, currently under a cooling trend (Gutiérrez *et al.*, 2011) (Figure 4).

The northern pilot area includes the following towns and/or fishing coves: Máncora, Los Organos, El Ñuro and Cabo Blanco (04°05 – 04°15'S), from which Máncora is the bigger town, so that we will name this area as Máncora from here to the rest of the proposal. In oceanographic terms, Máncora faces the seasonal north-south displacement of the Equatorial Front (EF), where the surface tropical waters (with high temperatures and low salinities) mix

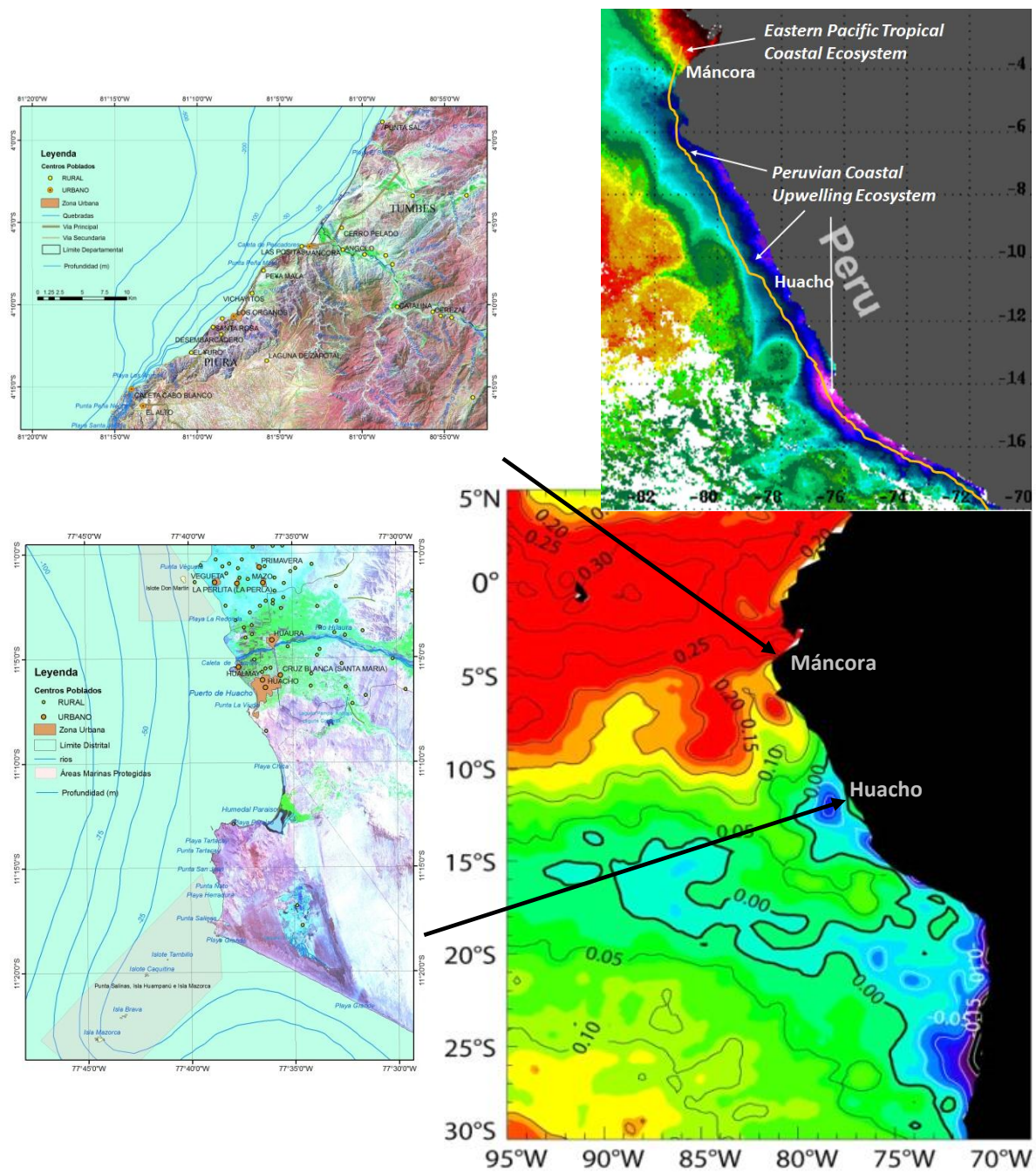


Figure 4. On left: Satellite maps of Mancora (above) and Huacho (below) coastal areas. On right, above: distribution of sea surface temperature (°C) along the Peruvian coast, for April, 2005 (modified from Bakun & Weeks, 2008); the approximate distribution of the target ecosystem is shown; the dark yellow line is the continental shelf extension; below: SST trends along the coast (Gutiérrez et al., 2011).

with the colder waters and higher salinities that characterize the coastal upwelling. The position of the EF is highly dynamic, exhibiting also interannual shifts in its latitudinal position. A summary presentation of the main characteristics of Mancora as pilot site is shown in Table A1 (Annex I).

The second pilot area is distributed from Don Martin Island to cape Punta Salinas (11°01'S – 11°19'S), and includes the following towns and/or fishing coves: Végueta, Huacho and Carquín from which Huacho is the principal one, so we will use its name to label this area in the rest of the project document. Here coastal upwelling is the driver for coastal marine life. The islands and Cape Punta Salinas belong to protected areas. The coastal-marine zone of Huacho and Carquín has nutrient rich waters with several important fishing grounds for artisanal fishermen. This area has also sandy shores that are used in summer by local population as recreational places, wetlands rich in migratory birds and islands with abundant areas for natural banks of marine invertebrates. A brief of the Huacho pilot area is given in Table A1 (Annex I).

In general terms, the group of adaptation measures to be implemented under component 1 can be classified in three different types: (i) expansion of improved fishing practices and promotion of environmental friendly gears; (ii) facilitating the emergence of eco-tourism activities and (iii) development of sustainable aquaculture banks in selected areas.

In order to facilitate the presentation of key information for each of the two specified pilot sites, two summary sheets have been developed, highlighting specific adaptation interventions per site. These are presented below. Additional detailed information can be found in the Annex I.

MANCORA

Coastal Marine Zone Characterization

The following table summarizes main factors that define Mancora coastal marine zone.

Factor/feature	General characterization of the pilot area
Area of intervention	Máncora to Cabo Blanco
Key physical forcing	Equatorial front
Coastal marine habitat	Vulnerability to climatic extremes (floodings, ENSO). Domestic (sewage) water pollution
Coastal biodiversity	Panamanian province and ecotone to Peruvian province (south); migration route of cetaceans and turtles
Main resources	Giant squid, Yellowfin Tuna
Main artisanal fishery resources/landings rank (Máncora)	Giant squid, Yellowfin Tuna(rank 21)
Anthropogenic pressure on top predators	Gillnet fishing – cetaceans and turtles
Hazards or conflicts in marine coastal management	Territory use/planning and climatic vulnerability and coastal marine pollution
Climatic projection hypothesis up to 2030	SST has already increased by +0.4 oC, further increases associated with increase probability of extreme precipitations

Table 2. Characterization of Mancora pilot site

Fishery

The following table presents a summary of main fishing factors per cove or area of influence of the project, including the number of employed vessels, number of fishermen and types of fishing arts used. Use of traditional fishing arts continues to be prevalent, with the use of non-specific gears and poor processing practices. It is estimated that 35 percent of all fishing boats use non-environment friendly gears.

Cove	Population	Number of fishermen	Number of vessels	Associated to trade unions	Type of fishing arts	Infrastructure	Main target species	Level of poverty
Cabo Blanco	7137	600	200	496	Purse seine, long-line	Breakwater, pier	Hake and scombrids	Poor
El Ñuro	9612	350	170	200	Long-line, hook	Breakwater, pier	Hake	Moderately Poor
Los Órganos	9612	400	105	223	Purse seine, gillnet	Breakwater, pier	Hake/giant squid	Moderately Poor
Máncora	10547	650	125	320	Gillnet	Breakwater, pier	Yellowfin tuna, scombrids	Moderately Poor

Table 3. Summary of fishing data for Mancora, updated to 2012 (Source: IMARPE)

This area is nowadays not a landing zone for the industrial fishery, but lies within the main distribution area of hake (*Merluccius gayi peruanus*), which is the main demersal⁸ resource off the Peruvian coast. Also it is the most important artisanal fishing zone for the Yellowfin Tuna and for other oceanic large-sized species.

Nearly all of the fishing activities in the coves are performed by artisanal vessels. They exhibit a high diversity of fishing arts (gillnets, long-line, hook and purse-seine) and fishing targets, dominated by the giant squid *Dosidicus gigas* (but with very high variability) and large oceanic fishes, as tunas, sharks and scombrids and coastal demersal fishes, including hake.

In general, the landings are characterized by a large variability in species composition and amount of landings, according to the highly variable oceanic conditions. Among the top three resources in landing statistics for the past decade there is the Yellowfish Tuna (*Thunnus albacares*). The landings of Yellowfish Tuna showed a tendency to increase in the past decade. It is worth to mention that the fluctuations of the landings of Yellowfish Tuna, and of other tropical oceanic species are related to ENSO. For instance, higher catches in 2003, 2007 and 2010, followed the moderate El Niño events in the past decade.

Banks and fishing grounds

⁸ Describing a fish that lives close to the floor of the sea or a lake (<http://www.thefreedictionary.com/demersal>)

Banks of several benthic resources are present in the pilot area but they are not well studied. There have been reported small banks of the Pearl oyster (*Pteria sterna*), from Máncora to Los Organos, and of the Oyster (*Ostrea iridescens*), north of Máncora to Punta Sal (Carbajal et al., 2010; Ordinola et al., 2010).

Socio-economic conditions

The coastal sector of Mancora is characterized for having several coves and bays from which fishing communities develop their activities. The main settlement is Mancora with a population of 10547 persons, composed mainly by fishermen (10.3%), car drivers (9.7%), shopkeepers and dealers (9.5%), followed by cooks, hotel personnel and bricklayers (about 5% each). In recent years Máncora has received an increasing number of national and foreign tourists, leading to a rapid construction of more hotels along its coastal line. Poor sanitary infrastructure (only 58% of houses are connected to the public sewer system) is the cause of serious risks of pollution affecting coastal marine activities. Other fishing communities are located in Cabo Blanco (population 7137, socio-economic level: poor), El Nuro (population 9,612, socio-economic level: moderately poor), and Los Organos (population 9612, socio-economic level: moderately poor)

Proposed adaptation response

Building resilience of the environmental services provided by the coastal marine ecosystems to climate change impacts through:

COMPONENT	ACTIVITIES
Component 1	<ul style="list-style-type: none"> ✓ Expansion of improved fishing practices and promotion of environmental friendly gears. ✓ Promotion of a fishery certification process for the artisanal fishery of hake and yellowfin tuna, following the Marine Stewardship Council overarching principles, in which the fishery must prove that it meets: i) fish stock sustainability; ii) minimal environmental impact; and iii) effective management (MSC, 2010), and access to high-value markets. ✓ Developing alternative and additional sources of income by facilitating the emergence of ecotourism.
Component 2	<ul style="list-style-type: none"> ✓ Deployment of a climatic and oceanographic onshore-offshore surveillance system, coupled with local bio-environmental monitoring, and a system for early warning of weather conditions, red-tides and extreme events. ✓ Output of models of local circulation, biochemical fields (oxygen, chlorophyll-a) and habitat distribution for key species, as forced by climatic changes of boundary oceanographic conditions. ✓ Baseline assessments leading to the management of natural banks and know-how for sustainable aquaculture of selected species.
Component 3	<ul style="list-style-type: none"> ✓ Support and technical assistances to fishermen associations for building self-organization and attain formal registration in the legal system.

	<ul style="list-style-type: none"> ✓ Training and technical assistances to fishermen associations for building management and marketing skills for ecotourism and fish products commercialization. ✓ Training fishermen in environment friendly practices facilitating access to improved fishing gears, and certification process. ✓ Education and training for basic environmental monitoring and for tasks of surveillance and control. ✓ Education and training to students and communities leading to sustainable management of coastal resources, natural banks and aquaculture, taking into account ecological risks under climate change. ✓ Training and strengthening government institutions responsible for creating the enabling environment for long-term sustainability. ✓ Training local scientists and key stakeholders in the use of science based information and tools related to the coastal marine ecosystem, following the EAF and EBA.
Component 4	<ul style="list-style-type: none"> ✓ Support local, regional and national agencies in the selection, analysis, development of management plans and management of marine protected areas and no-take zones, and development and implementation of marine coastal ecological zonification plans. ✓ Support local, regional and national agencies for the sustainable management of fishing grounds and fisheries resources, by introducing incentives for community management and improved information and knowledge to inform on optimal catching volumes, according to EAF. ✓ Support the implementation of an ecological risk assessment process for selected key species that inhabit the pilot area, in relation to climate change impacts, as tools for adaptive management. ✓ Supporting national and regional governments enacting regulations and executing measures for facilitating the EBA and applying the EAF, as: a) pollution abatement and conservation of coastal habitats; and b) introduction of regulations and policies empowering local communities to co-manage marine concession areas.

Table 4. Summary of adaptation measures showing the articulation among project components in the pilot site of Mancora

HUACHO

Coastal Marine Zone Characterization

Factor/Feature	General characterization of pilot site
Area of intervention	Don Martin Island/Végueta to cape Punta Salinas
Key physical forcing	Coastal winds
Coastal marine habitat	Subjected to chemical pollution (fisheries, agriculture) and

	domestic sources. Vulnerability to climate extremes (el Nino)
Coastal biodiversity	Wetlands, islands and inlets; habitats for migratory birds, colonial guano bird and marine mammals
Main resources	Anchovy (Central-Northern stock)
Main artisanal fishery resources, landings rank	Anchovy, scombrids, coastal fishes
Anthropogenic pressure on top predators	Pressure on habitat areas of marine birds and mammals
Hazards or conflicts in marine coastal management	Territory use/planning and climatic vulnerability, coastal marine pollution
Climatic projection hypothesis up to 2030	High degree of uncertainty (cooling or warming)

Table 5. Characterization of the Huacho pilot site

Fishery

The recent coastal cooling trend of Central and Southern Peru has not been translated in a positive trend of anchovy's biomass, which has exhibited interdecadal fluctuations following changes in upwelling and oxygenation (Bertrand et al., 2011). Since year 2000, the biomass is rather stable at about 10 to 12 million of tons (Freon et al. 2008). Nevertheless acoustic biomass estimations suggest a northward shift in the gravity center of the population, from about 12 – 14 °S in the 1970's to 6 – 8°S in the last decade (M. Gutiérrez et al., accepted). The large fishing capacity by the industrial fleet (Fréon et al., 2008) might have limited the biomass growth, but other ecological factors linked to the environmental change could also have limited the carrying capacity.

Historically the Huacho harbor has been an important landing point for the industrial fishing of anchovy and several factories for fish meal and oil production are established. Since 2009, the artisanal fleet is fishing the anchovy, encouraged by the government policies to increase the direct human consumption, and now anchovy landings represent over 90% of the total artisanal fishery landings in the area. As other areas subjected to coastal upwelling, the waters are cold and very productive, being the natural habitat of the Peruvian anchovy *Engraulis ringens*. The topography favours the existence of natural banks of benthic invertebrates, among which there are several subtidal mollusk species of high commercial value and demand.

However, the use of purse seines with a mesh size of only 38mm, which is adequate for anchovy, has an impact on the higher prized species because it extracts mostly juveniles and creates conflicts with the gillnet fishermen which target the same species. Furthermore, this fishing gear is not appropriate for the pretended use of direct human consumption, because the product arrives in damaged condition due to the character of the fishing practice, so that it is offered for the fish meal factories. The final effect is adding fishing pressure and increasing the vulnerability of this resource and of other coastal species. Therefore an adaptation strategy is needed to effectively reduce the fishing pressure on the fish species, while improving the incomes of the fishing communities, which all together would improve the socio-ecological resiliency to climate change impacts.

Exploitation of natural banks of benthic invertebrates

The topography favours the existence of natural banks of benthic invertebrates, among which there are several subtidal mollusk species of high commercial value and demand. Some of the major banks are located onshore Don Martin Island, and in the cape Punta Salinas which are protected areas, offering a chance for their sustainable management. Two of the main benthic resources with high commercial value (for export and for national consumption) are the Peruvian scallop (*Argopecten purpuratus*) and the razor clam (*Ensis macha*).

In the Huacho area, the main natural bank of the razor clam is in cape Punta Salinas, whereby hydraulic dredging has also been reported. Even that this practice has been forbidden by law, it is still a threat over the population and its habitat due to the lack of effective control and attractive fishing gears for economic profit. In Punta Salinas, a ban established in 2008 has allowed the recovery of the adult population but the restoration of the silty sand bottoms are slow, putting in danger the renewal of the bank (IMARPE, 2011).

The following table presents a summary of main fishing factors per cove or area of influence of the project, including the number of employed vessels, number of fishermen and types of fishing arts used.

Cove	Population	# of fishermen	# of vessels	Associated to trade unions	Type of fishing arts	Infrastructure	Type of catch	Level of poverty
Vegueta	18,265	160	50	160	Gillnet	No breakwater pier available	Small coastal fish	Poor
Huacho	53,998	907	243	907	Gillnet, purse seine, long-line, hook	Breawater pier, standard generation set, areas for fish manipulation	Chilean Jack Mackerel and Peruvian anchoveta	Acceptable
Carquin	6,091	250	150	250	Gillnet	No breakwater pier available	silverside and lorna drum	Poor

Table 6. Summary of fishing data for Huacho, updated to 2012 (Source: IMARPE)

Socio-economic conditions

In Huacho, the main economic activity is small scale commerce (9.2 % of population), teaching (7.9 %) – mainly related to the Huacho University – restaurants (6.1 %), building (4.6 %), transport (4.6 %) and fishery (3.2 %). In Carquin, economic activities comprise small scale commerce (17.5 %) and fishery (15.3 %), with two fishmeal plants, and artisanal harvest for direct human consumption. Also, in Carquín other activities such as agriculture, cattle, poultry, bovine and pork industries are developed.

Administratively, this pilot area belongs to the Huaura province (197,384 inhabitants), from which the main district, harbor and population center is Huacho (53,998 inhab). The two other districts with coastal populations and fishing coves are Carquín (6,091 inhabitants) and Végueta (18,265 inhabitants). The number of people working in the artisanal fishery are 907, 250 and 160, respectively, so that the families that depend directly from this economic activity are about 1300.

Proposed response

The three main artisanal fishery resources for Huacho coastal communities (e.g. Anchovy, Peruvian scallop and razor clam) are sensitive to climate-driven oceanographic changes and their distribution have responded to the recent environmental changes, but their future behavior is uncertain due to the non-linear character of the climate change impacts in the upwelling ecosystem (Echevin et al., 2011). Therefore adaptation measures need to be applied to maximize the opened opportunities and to minimize the vulnerabilities of the resources driven by the current fishing practices, limited information of the coastal ocean dynamics/ future regional climate change scenarios, and management limitations.

The table presented below is meant for providing a summary of the main adaptation actions in Huacho, which aims to improve the resilience capacity of the main fishing resources and of the local fishing communities. A more comprehensive description is available in the Annex I.

COMPONENT	ACTIVITIES
Component 1	<ul style="list-style-type: none"> ✓ Sustainable, fishing practices and promotion of environmental friendly fishing gears (lift nets) with profitable products (e.g. anchovy); ✓ Promotion of extensive aquaculture as an economic alternative (e.g. Peruvian scallop) and stocking of natural banks in protected areas to create sources of larval supply for new aquaculture projects. ✓ Re-stocking of natural banks of benthic invertebrates (e.g. razor clam) through the implementation of no-take zones and areas for controlled extraction in protected areas. ✓ Promotion of a fishery certification process for the artisanal fishery of anchovy and razor-clam, following the Marine Stewardship Council overarching principles, , and access to high-value markets.
Component 2	<ul style="list-style-type: none"> ✓ Deployment of a climatic and oceanographic onshore-offshore surveillance system, an early warning system and a bio-environmental monitoring of the islands, capes, banks and culture systems within and outside the protected areas. ✓ Output of models of local circulation, biochemical fields (oxygen, chlorophyll-a) and habitat distribution for key species, as forced by climatic changes of boundary oceanographic conditions. ✓ Strengthening applied research activities leading to the management of natural banks and know-how for sustainable aquaculture of selected species.

Component 3	<ul style="list-style-type: none"> ✓ Support and technical assistances to fishermen associations for building self-organization and attain formal registration in the legal system. ✓ Training and technical assistances to fishermen associations for building management and marketing skills for sustainable aquaculture and fish products commercialization. ✓ Training fishermen in environment friendly practices facilitating access to improved fishing gears, and certification process. ✓ Education and training for basic environmental monitoring and for tasks of surveillance and control. ✓ Education and training to students and communities leading to sustainable management of coastal resources, natural banks and aquaculture, taking into account ecological risks under climate change. ✓ Training and strengthening government institutions responsible for creating the enabling environment for long-term sustainability. ✓ Training local scientists and key stakeholders in the use of science based information and tools related to the coastal marine ecosystem, following the EAF and EBA.
Component 4	<ul style="list-style-type: none"> ✓ Supporting the formulation and implementation of the Master Plan for the Reserve of Islands, Islets and Capes in the Huacho area and improve its control capacity over its radius of competence, establishing permanent ‘no take’ areas, transient ‘no take’ areas for the re-stocking of natural banks, areas for special concessions for extensive aquaculture to artisanal fishermen, areas for ecotourism use, and also areas for scientific experimentation and environmental monitoring. ✓ Supporting national and regional governments enacting regulations and executing measures for facilitating the EBA and applying the EAF, as: a) implementation of the Economic and Ecological Zonification of the marine coastal environment; b) pollution abatement and conservation of coastal habitats; and c) introduction of regulations and policies empowering local communities to co-manage marine concession areas. ✓ Support local, regional and national agencies for the sustainable management of fishing grounds and fisheries resources, by introducing incentives for community management and improved information and knowledge to inform on optimal catching volumes, according to EAF. ✓ Support the implementation of an ecological risk assessment process for selected key species that inhabit the pilot area, in relation to climate change impacts, as tools for adaptive management..

Table 7. Summary of adaptation measures showing the articulation among project components in the pilot site of Huacho

Component 2. Deployment of a modern and efficient environment surveillance, prediction and information system in the marine-coastal ecosystems at regional and local scales supporting marine economic activities and fisheries adaptive management under the EAF principles

The output of this component is a modern system of climatic and oceanographic surveillance, forecasting and long-term prediction, including biological, physical and chemical variables, which will be used for early warning and for supporting ecotourism, aquaculture and fishing activities as well as adaptive fishery management.

The ocean climate and the marine productivity of Peru are controlled by a few main factors, namely: 1) the Walker Circulation, which sets the depth of the thermocline⁹, influencing the fertility of the subsurface waters; 2) the intensity of coastal winds that drive upwelling of those subsurface waters and promote mixing in the upper water column; and 3) the spatial distribution of surface to subsurface water masses. In turn, air-sea interactions feed back on the continental climate; e.g. on the precipitation anomalies in the North or on the low-atmosphere cloud cover in the rest of the coast. Current information deficits¹⁰, originated by the lack of: (i) sufficient ground measuring stations and (ii) remote observation and monitoring data, limit the understanding of the interaction among the main factors mentioned above. The proposed adaptation measure is designed to fill the gaps of information, through an improved system of climatic/oceanographic surveillance and prediction.

For the surveillance component, at each pilot area, this system will consist of: a) periodic (weekly) 80-km onshore-offshore oceanographic sections (0 – 200 m) carried by autonomous devices (gliders), equipped with sensors of temperature, salinity, oxygen, pH and chlorophyll-a; b) continuous (e.g. hourly) SST and surface salinity recording within bays, capes, islands, oil platforms and/or intervention sites (natural banks or aquaculture areas); c) continuous (e.g. real-time) recording of the weather conditions, coastal winds velocities and

⁹ As one descends from the surface of the ocean, the temperature remains nearly the same from the surface down to a certain depth, but decreases rapidly from that point downward. This boundary is called the thermocline. (NOAA <http://www.weather.gov/glossary/>)

¹⁰ Current land-ocean climate monitoring platforms are insufficient to determine the key parameters at the right timing for a proper warning system on meteorological and oceanographic conditions, as well as potential events triggered by the warming or cooling processes (e.g. possible increase of El Niño events, more frequent wind storms). Subsurface fields of currents, temperature and salinity (which influence upwelling) are measured in seasonal to semiannual intervals, but little is known on the synergy between large-scale anomalies with smaller-scale local to regional atmospheric processes that can amplify the anomalies physically or ecologically.

Moreover, it is also known that coastal winds over the first 50 km offshore are poorly sampled by satellite data and occasional scientific cruises (Echevin et al., 2011). The meteorological network at the coast is restricted to a few airports, which are not necessarily located in exposed areas to have a better representation of the upwelling winds. Nearly real-time surface water masses distribution is currently inferred from remote-sensing Sea Surface Temperature (SST) fields, but this is severely limited by salinity information, particularly in the North, where a large salinity gradient occurs with the Equatorial Front. Finally, current monitoring of properties, which are not conservative such as oxygen and pH is still sparse in time and in space.

directions, by marine coastal meteorological stations located on capes or islands, which will be complementary to the national meteorological stations network; d) periodic bio-environmental monitoring at selected sites and/or the intervention sites, for ecosystem health indicators in plankton, benthic habitat quality, distribution of key species, and supportive chemical variables as pH and oxygen. The latter will enable the development of baseline studies needed to provide the science-basis for management of natural banks and sustainable aquaculture practices.

In addition, IMARPE's facilities will be improved for storing, analyzing and disseminating international satellite data (e.g. SST, ocean color, altimetry, winds). Data of the marine and meteorological stations will be exchanged with other climate research institutions, and a proper near real-time interface to disseminate the information to the community will be opened in the IMARPE's information center webpage. The data will be accompanied by periodic reports oriented to the early warning on weather, climatic or oceanographic conditions, including those related with ecosystem health, as red tides, anoxia, or jellyfish blooming (see also Component 3).

The repetitive oceanographic sections will deliver useful information both at regional and at local scales, since they will cover from near to the coast to beyond the continental shelf extension down to 200 m of water depth. Therefore the main coastal circulation processes will be monitored. In the North, the meridional displacement of the Equatorial Front and the Equatorial Undercurrent activity will be determined. Off Huacho, the zonal displacement of the upwelling front as well as the cross-shore advection processes and the activity of the Peru-Chile undercurrent will be tracked. It is important to note that the fronts' positions are related with the habitat size of nektonic resources¹¹, as the anchovy, the giant squid or the yellowfin tuna in the North. Monitoring of chlorophyll-a and dissolved oxygen will indicate the status of biological productivity, as well as the vertical habitat size for pelagic resources and the habitat quality for aerobic demersal and benthic organisms. Measurements of pH will allow recording the response of the acidity conditions that might be amplified or buffered due to variations in SST and coastal productivity.

The implementation of the gliders' platform will require a sustained system to ensure proper buoyancy and navigation of the devices, as well as basic capacities for their electronic maintenance. Also, at least one backup device is needed in order to guarantee a continuous surveillance at each pilot area. Therefore five gliders will be acquired by the project, and facilities will be installed at IMARPE headquarters for the maintenance and tests of the equipment. Recruitment and training of personnel will lead to implement an electronics team in IMARPE that will contribute to give sustainability to the surveillance platform beyond the end of the project. Furthermore, the oceanographic instrumentation of the coastal laboratories of IMARPE will be improved in order to complement the surveillance at local level and ensure the data quality from nearshore areas.

On the other hand, local weather forecasting will be improved by the information provided by the meteorological stations and the satellite data mentioned above. The meteorological data will be integrated in the network of the Peruvian Survey of Meteorology and Hydrology (SENAMHI), which is the official institute that delivers weather forecast in the country.

¹¹ The collection of marine and freshwater organisms that can swim freely and are generally independent of currents, ranging in size from microscopic organisms to whales. (<http://www.thefreedictionary.com/nektonic>)

For long-term prediction purposes, improved computing facilities at the modeling unit of IMARPE will allow to yield: (i) an implemented, calibrated and verified high resolution model of the physical processes in the marine coastal environment; (ii) an implemented, calibrated and verified high-resolution bio-physic-chemical coupled model representing impacts on high and low trophic levels of the ecosystem; (iii) analyses of impacts of climate change by 2030 on biomass production under a pessimistic and optimistic IPCC climate scenarios and (iv) economic valuation of the predicted impacts of climate change on the regional industrial/artisanal fisheries (jointly with adaptation measure 4).

Currently, there is great uncertainty about the specific impacts of climate change on Pacific coastal upwelling ecosystems. On the one hand, the hypothesis of coastal warming (Vecchi, 2010) is based on a potential weakening of the Walker Circulation¹². On the other hand, the hypothesis of upwelling enhancement (Bakun, 1990) is based on the expected strengthening of the coastal winds due to the increase of thermal gradients between the land and adjacent coastal ocean. Recent simulations suggest a warming scenario, but the retrospective trends suggest a cooling scenario for the Central-Southern Peruvian coast.

Therefore this component, through the deployment of state of the art monitoring technology and complementary modeling activities, will help reducing uncertainty of current available estimations of climate change impacts on the Peru's coastal marine ecosystems. This will be achieved with the help of high-resolution simulations of the physical manifestations like temperatures, salinities and currents, and the biological responses to climate change at regional and local spatial scales, and for short-term and long-term climate scenarios and decision-making.

The physical processes in the Peru's coastal marine ecosystem will be modeled with the Regional Ocean Modeling System (ROMS)¹³ (Shchepetkin & McWilliams, 2005; Penven *et al.*, 2005) that will be forced by high resolution data extracted from the Weather Research and Forecasting (WRF) model¹⁴. Outputs from models of the Intergovernmental Panel on Climate Change (IPCC) (Marti *et al.*, 2010) will be used to provide the initial and boundary conditions for the WRF model. A pessimistic (RCP8.5) and an optimistic (RCP3PD) scenario will be used at different time-slices as required.

This physical model will be coupled to a bioclimate envelope model (Cheung *et al.* 2008, 2009) in order to predict future changes in habitat distribution, relative abundances and catch potentials of characteristic species from the coastal upwelling systems along the Peruvian coast. The bioclimate model consists in identifying a set of physical (e.g. SST, oxygen) and biological conditions that are suitable to a given species. Thus, shifts in species distributions can be predicted by evaluating changes in bioclimate envelopes under climate change scenarios. The application of this approach has allowed the prediction of global and regional changes in fish biodiversity, biogeography and fisheries production under climate change scenarios (Cheung *et al.*, 2009, 2010). For the achievement of this goal, IMARPE's

¹² Being the result of a difference in surface pressure and temperature over the western and eastern tropical Pacific Ocean, the Walker Circulation is an ocean-based system of air circulation that influences weather on the Earth.

http://www.windows2universe.org/earth/Atmosphere/walker_circulation.html&edu=mid

¹³ ROMS is a free-surface, terrain-following, primitive equations ocean model widely used by the scientific community for a diverse range of applications <http://www.myroms.org/>

¹⁴ A next-generation mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs <http://www.wrf-model.org/index.php>

modeling unit will need to be reinforced so the required technical capacity needed to perform the modeling is met.

Finally, a bio-economical model, characterized by the use of economic information of prices, costs as well as fishery information of catches and biomasses will be applied to assess the economic impact of climate change on the main fishery resources for both IPCC scenarios (Van den Bergh *et al.*, 2006). These predictions will provide the scientific basis for a better understanding of the economic impacts of climate change on the Peru's coastal marine ecosystem and the assessment of suitable and cost-effective adaptation measures.

All together, monitoring, modeling and prediction will contribute to the development of Ecological Risk Assessments (ERAs) related to climate change impacts on biotopes, natural banks and key selected species (see below).

Component 3. Capacity building and knowledge management system for implementing the EBA and the EAF, and for the dissemination of project's lessons learned, targeting government officials, academia, stakeholders and local communities

The main outputs of this adaptation measure include:

1. Capacity building, training and organizational support, for the implementation of EAF, including management training, training on environmental friendly practices and gears.
2. Training community and local entrepreneurs on developing alternatives sources of income including eco-tourism and aquaculture of selected species.
3. Training and technical assistance for certification
4. Education and training for basic environmental monitoring and for tasks of surveillance and control.
5. Technical and scientific training on basic competencies for the formulation and implementation of EAF and selected Ecological Risk Assessments (ERAs). This activity will focus mostly on capacity building for national agencies, academia and research institutions.
6. Technical and managerial staff from IMARPE and PRODUCE trained in the use of the new science-based tools provided by the project for the decision-making in the fisheries management and for the application of the EBA;
7. Undergraduate/graduate theses on: a) population studies related to the most important artisanal fishing resources in order to guarantee its sustainable use; b) studies of alternative economic activities for artisanal fishers and their families for each pilot area; and c) studies about risks and vulnerability of fishing and aquaculture activities as well as of the coastal communities.

Outputs 1, 2 and 3 directly support the proposed interventions in the Component 1 (sustainable fishing practices, eco-tourism, aquaculture and fishery certifications). Output 4 will directly support the monitoring activities, by building capacities for their operation and sustainability beyond the project (Component 2). Outputs 5 and 6 will be key to build capacities for improving the regulation framework, and the decision-making processes (Component 4). Finally, output 7 will support monitoring, baseline and modeling activities in Component 2, but also will allow the improvement and/or design of interventions in the pilot areas (Component 1), contributing herewith to science-based decision-making in Component 4.

The project's approach is to increase the resilience of the ecosystems and of the coastal communities by supporting win-win adaptation measures at different levels, in which the main tools are the partnership between the state and the communities for the rational use of the resources, the co-management on the target resources or the incentives for entrepreneurial activities leading to economic diversification.

Thus, a primary condition for the feasibility and sustainability of the adaptation measures and their upscaling to country-level is to build the self-organization capacities of the affected communities. For achieving this goal, at each pilot site seminars and courses will be given to the artisanal fishermen to increase their awareness of the benefits to have legal recognition, providing the law requirements and regulations which should be followed for establishing the formal organizations. In addition, local promoters will provide assistantship to the fishermen associations that undertake the process, and also will work on engaging other community members for joining the self-organization process.

Replacement of non-selective for selective fishing gears will require demonstrative training. Through agreement with the fishermen associations, one or a limited number of fishing boats will be equipped with the new fishing gears for training the fishermen until they acquire the skills; also it will be provided all the information for the gear life-cycles, maintenance costs and adaptation needs in the fishing units. In parallel, seminars will be offered to the fishing communities to transfer the knowledge on the benefits of adopting the new fishing practices in terms of resource sustainability, quality of their incomes, and compliance with the management policies. The gears' replacement for the target fleet will take place once the training phase will be achieved.

Technical assistance will be given for fishery certification, first by disseminating the benefits of the certification for improving the value of the fish products, then by giving assistantship during the different phases of the process (pre-certification assessments, steps to encompass to meet the requirements, etc.), including those requirements related to the improvement of the management plans for the target species. For the latter, technical training will also be given to policy-makers and management scientists in order to ensure that management plans meet the certification standards.

In the pilot sites, assistantships for enterprise management, marketing and for business plans will be provided to ensure a profitable demand of the fish products. For those small enterprises to be constituted for eco-tourism and aquaculture, training and/or assistantships will not be limited for know-how and technological needs, but also for giving the basic skills for an adequate enterprise management, marketing and business plans. Seminars and short course cycles will be organized and offered to local communities and fishers' family members, particularly local students about these issues. Finally, education and training will also be provided for tasks of basic environmental monitoring, surveillance and control. These responsibilities will be offered as means of partnership with the project, and they will help to internalize the co-management approach.

Given these elements, it is clear that the capacity building component is an essential part of the adaptation project. The needs for training and assistantships to the communities imply a major effort in terms of awareness campaigns, courses, seminars and assistantships. An approach that will be applied is to carry out training and education for local promoters, who will be able to disseminate the education contents for a larger universe of potential beneficiaries, following a well structured Knowledge Management Strategy (KMS). The KMS also includes a continuous, opened and friendly web information system reporting local

weather conditions and early warnings for oceanographic or environmental events as red tides, jellyfish blooming, or anoxia for the local stakeholders, scientific community and general public (see also Component 2). In addition, the website will publish news, guidelines, technical material, information on good practices and program's lessons learnt targeting the fisheries community and including the general public, stakeholders, local communities and academia (see also section G).

It should be noted that all of these efforts will be articulated with existing agencies or actions plans on entrepreneurial capacity building in the local, regional and government levels. For example, the Ministry of Production, to which the Viceministry of Fisheries belongs, includes a Viceministry of Small and Medium Enterprises and Industries, whereby several programs to reduce poverty and increase social inclusion take place. In addition, the project will support communities and fishermen associations to make use of the consultation mechanisms for the planning of annual budget, in order to get funding support for actions oriented to multiply training and education programs for the artisanal fishing communities.

On the other hand, training and continuous formation of technical and scientific staff are needed to achieve a sustainable expertise in the application and/or implementation of the principles of the EBA and the adoption of an Ecosystem Approach to Fisheries¹⁵ (EAF) by the fishery management system. EAF recognizes the interdependence between ecosystem health and human well-being and the need to maintain ecosystems productivity for present and future generations.¹⁶ This effort will encompass a more intense collaboration with the academic system, and national and international scientific institutions.

The Ecological Risk Assessment methodology will form the basis for an effective implementation of the Ecosystem Approach to Fisheries (Fletcher *et al.*, 2002; FAO, 2003, 2005). The ERAs are currently being used for assessing climate change impacts in fisheries and key species of marine ecosystems. The ERAs can provide thorough assessments of the sensitivity and tolerances of critical life history stages, habitats and phenologies of key species to climate change drivers. Then they contribute to identify key issues that will affect policy decisions and management arrangements. These risk assessments and the targeted scientific studies that may follow from this prioritisation will be necessary for ensuring that the potential impacts of climate change on key marine resources are also communicated effectively to the government and stakeholders. This approach will help to ensure the development of policies and intervention measures to mitigate existing or future risks, by optimizing adaptation responses (e.g. by providing flexible management arrangements) and seizing opportunities as they arise (e.g. for species where productivity increases) (Pecl *et al.*, 2011).

¹⁵ EAF is defined by Ward *et al.* (2002) as “an extension of conventional fisheries management recognizing more explicitly the interdependence between human well-being and ecosystem health and the need to maintain ecosystems productivity for present and future generations, e.g. conserving critical habitats, reducing pollution and degradation, minimizing waste, protecting endangered species”.

¹⁶ In terms of climate change adaptation and building resilient systems (i.e. including reducing exposure and increasing adaptive capacities), the application of the EAF would be an important contribution to maintaining biodiversity, preserving the resilience of human and aquatic systems to change, and improving our capacity to anticipate and adapt to inevitable climate induced changes in aquatic ecosystems and the related fisheries production systems. (*Fisheries and aquaculture in our changing climate: adaptation and mitigation measures in fisheries and aquaculture*, 29th Session of the Committee of Fisheries, Italy 2011)

As this is a relatively new approach to fishery management, adequate training will have to be provided for staff from the Vice-Ministry of Production and IMARPE in order to ensure a widespread understanding of its value and effectiveness as well as its correct implementation. Staff will also be trained in the use of outputs from scientific models (see adaptation measure 1) and from the ocean monitoring and ocean surveillance system to be implemented through adaptation measure 2.

The project will seek also the inclusion of local universities, by supporting undergraduate or graduate applied research theses, as basis of technical notes that will provide support to sustainable management of coastal resources, natural banks and aquaculture, as well as study-cases of ecological risks assessments under climate change, and vulnerability assessments of local coastal communities. The outputs of this measure will complement and support monitoring, baseline and modeling activities given in Components 1 and 2 and to activities and needs in Component 4. The vulnerability assessments of local coastal communities will be carried out to generate information at a finer scale (community level) on their level of exposure and sensitivity and better inform the design and implementation of planned adaptation measures.

Component 4. Management policies, regulations and measures promoting the resiliency of coastal ecosystems and local communities to climate change and variability-induced stress

Two major external factors are likely to shape Peruvian fisheries in the future: (a) the continuous growth in global demand for fishmeal and fish oil (Merino *et al.*, 2010), and (b) the expected influence of climate change on the frequency and intensity of ENSO events (Tsonis *et al.*, 2003). The degree to which these factors will affect the sector's economic, environmental and social performance will depend largely on the capacity to build a legal and regulatory environment conducive of a more economically viable and biological resilient sector.

In this regard, the business as usual in the management and governance of the fisheries, especially the artisanal, system, is not an option. Currently, artisanal fisheries possess right to fish within 5 nautical miles of the coastline. However, due to changes in location and abundance of catch, artisanal and industrial fisheries frequently interfere leading to conflict and increased pressure on the natural resources. Leaving the current system of weak governance and major regulatory gaps in place will likely create additional stress in the biological system and accentuate the cycles of collapse and slow recovery. These will further increase inefficiency in the utilization of the fishing and processing investments, exacerbate stress on the ecosystem and result in poor returns from the sector to Peru's economy. Strengthening the governance of the sector could reduce some of the losses and capture significant benefits in ecosystem resilience to the expected impacts of climate change.

The main objective of this component is to create the enabling condition for the successful implementation of community based management of coastal marine ecosystems in Peru. Diagnostics and analysis of the current situation with fisheries and artisanal fishing indicate that challenge posed by the surveillance and control of landing in many sites, by many boats targeting different species in the most productive marine ecosystem in the world. It is clear that the GOP does not have the capacity to control this artisanal activity, and that new approaches are needed.

One such approach is to empower the community, and create the incentives for, the management of the natural resources upon which their livelihoods depend. Co-management of coastal - marine ecosystem is not new. But its application and implementation in Peru to artisanal fisheries is. Therefore, this component seeks to work with all key stakeholders in creating the legal framework and the organization set up required empowering the community in their responsibility to manage their source of income and wealth. As the institutional framework is developed the community will be trained (component 3) to strengthen their organization; to better understand the functioning of the ecosystem to anthropogenic activities; to execute the tasks of surveillance and control; to collaborate in the ecosystem monitoring; in developing effective relations with government agencies involved in coastal marine areas; and, in managerial habits and skills to run community organizations and to co-manage the area under their administration.

This component seeks to frame the creation of community management of coastal marine ecosystem within efforts developing and implementing a science-based decision-making process concluding in a comprehensive implementation of the EAF¹⁷ in the Peruvian coastal marine ecosystems. In addition to components 1-3, described above, this component will particularly focus on the support to the national and local governments developing and implementing a governance strategy that takes into consideration all relevant stakeholders, empowers the community to manage the coastal marine ecosystem, regulates the access to the riches of the ecosystem under community management, and creates an enabling environment for the long-term sustainability of the artisanal fishery. This governance strategy will include the improvement of current land use policies, e.g. through technical support in adequate risk assessments which consider coastal vulnerabilities to climate change. In addition, it will include the equitable allocation of property and fishing rights in order to ensure sustainable development, the effective application of surveillance and control on the exploitation of the coastal marine ecosystem, a community agreed distribution of social benefits of the common uses of the ecosystem, and the exclusivity of the fishing rights. This will require intense collaboration with artisanal fisheries in order to jointly develop alternative, non-traditional sources of income.

This will be accomplished through: (i) Supporting national and regional governments enacting regulations and executing policies facilitating the EBA and applying the EAF, such as empowering communities to participate in the management of coastal marine areas, implementing of the Economic and Ecological Zoning of the marine coastal environment, planning and investing on pollution abatement and conservation of coastal habitats; and introducing regulations and policies empowering local communities to co-manage marine concession areas; (ii) Supporting the formulation and implementation of the Master Plan for the Reserve of Islands, Islets and Capes in the Mancora and Huacho areas and improve its control capacity over its radius of competence, establishing permanent 'no take' areas, and other regulations on the use of marine coastal resources; (iii) Supporting local, regional and national agencies for the sustainable management of fishing grounds and fisheries resources, through incentives for community management and improved use of scientific information and knowledge to inform decision-making (i.e. optimal catching volumes) according to EAF; and, (iv) Supporting the implementation of ERAs for selected key species that inhabit the pilot area, incorporating climate change impacts, as tools for adaptive management.

¹⁷ EAF recognizes the interdependence between human well-being and ecosystem health and the need to maintain ecosystems productivity for present and future generations.

Finally, this component will assess the convenience and viability of a sector-driven stabilization fund to address the risk of volatility in fish stocks and landings.

B. Describe how the project/ programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities.

The fishing sector employs around one hundred sixty thousand (160,000) people. Fish products make up 11% of Peru’s exports. Artisanal fishing is an activity that employs many people. They provide the basic source of protein and food for people living along the coastline. Despite the importance of artisanal fisheries in food production, 54% of artisanal fishermen¹⁸ are under the poverty line, lacking basic health and education. Therefore artisanal fishing communities are very vulnerable communities to climate change impacts.

Direct beneficiaries of this proposal will include fishers receiving environmentally friendly fishing gears, support for fishery certification, material and support for ecotourism, aquaculture and restocking of natural banks. The artisanal fishing communities which will benefit from these interventions are: Mancora, El Nuro, Organos and Cabo Blanco in northern part of Peru, and Vegueta, Huacho and Carquin in the central part of Peru.

An initial number of beneficiaries per type of adaptation measure is summarized in the following table.

Intervention	Beneficiaries
Sustainable fishery	500 fishers of Mancora, El Nuro, Los Organos and Cabo Blanco coves.
	About 100 fishers of Huacho with new environmentally-friendly fishing gears .
Ecotourism	At least 50 fishers, organized in at least 2 small cooperative enterprises
Aquaculture	100 fishers members of 3 fishers associations involved in aquaculture, creation of aquaculture enterprises owned by the artisanal communities..
Stocking / Restocking of natural banks	100 fishers members of 3 fishers associations involved in restocking of natural banks.

Table 8. Direct beneficiaries of the project.

Indirect beneficiaries include fishers from other coves which will learn successful lessons from the pilot areas. According to updated information from IMARPE sources (Tables 3 and 6), by 2012 the Máncora cove has about 650 fishers and 125 boats, El Ñuro cove has 350 fishers and 170 boats, Los Órganos cove has 600 fishers and 105 boats, and Cabo Blanco

¹⁸ Latarsha Dansie “Socioeconomic status and prospects of the fishing industry”, Riso Centre, available at: <http://www.centrorisorse.org/socioeconomic-status-and-prospects-of-the-fishing-industry.html>

cove has 600 fishers and 200 boats. These numbers give around 2200 fishers in all the coves, and taking into account the direct family members, at least 8000 people depending on fishery activities, which will be indirect beneficiaries in this pilot area.

Similarly, by 2012 the Végueta cove has 160 artisanal fishers and 50 boats, the Huacho fishing harbor has 907 fishers and 243 boats, and Carquin cove has 250 fishers and 150 boats. These numbers give around 1307 fishers in all the coves, and taking into account the direct family members, at least 6000 people depending on fishery activities, which will be indirect beneficiaries in this pilot area.

An initial group of benefits per type of adaptation measure is summarized in the following table.

Sustainable fishing and marine certification	
Economic benefits	Increased income of fishers due to increased quality and value of fishes, higher price of fishery products
	Savings in operative costs of fuel associated to change of fishing gear
	Increase of employment for processing and marketing fishery products
	Improved management of the fishery resource
	Fishery certification allow access to international market
Environmental benefits	Increased biodiversity, resilience of marine ecosystems and recovery of depleted species
	Increased selectivity of fishing gears and reduction of bycatch
	Reduction of greenhouse gases coming from
	Improved precautionary and adaptive management of natural banks and fishing grounds using the Ecosystem approach to Fisheries
Sociocultural benefits	Improved food security providing high quality seafood
	Conservation of fishery resources for recreation, ecotourism, education and ethical value
Ecotourism	
Economic benefits	Economic diversification by means of a fee for using the boats, harbour, touristic circuit, guidance
	Improved local infrastructure, generation of positive externalities (handcraft, food, etc.)
Environmental benefits	Promote creation or expansion of future marine protected areas and implementation of Master Plans at islands and points
Sociocultural benefits	Increased environmental consciousness of local communities and visitors
Aquaculture	
Economic benefits	Increased income due to increased offer of high quality fishery products for export to international market

	Increased employment, through processing and marketing activities.
Environmental benefits	Comanagement of natural banks and aquaculture ensure sustainability of production
	Restocking of natural banks complementing aquaculture activities with no take zones in marine protected areas
	Better knowledge of environmental and biological parameters of species under intervention through monitoring and modelling
Sociocultural benefits	Promote fishers to develop their own enterprise, with competitive advantages, potential certification and access to national and international markets
	Improved management of fishery resources
	Participation of youngs and women in processing of aquaculture products
	Availability of marine resources for future generations

Table 9. Tangible and intangible benefits derived from interventions

On the other hand, it is expected that incorporating new concepts of operation and management of marine resources, will develop a sustainable and stable production, will increase the commercial value of the catch, and will also contribute to the creation of new and complementary sources of employment, improving the socioeconomic conditions of fishermen and their families.

If no interventions are made in a short-time period, the fishery sector of Peru, and the coastal fishing communities that depend on it will be strongly affected. Low ecosystem productivity, foreseen species migrations and changes in their habitats due to changes in ocean temperatures, will lead to a smaller fish stock availability in the ecosystem, directly affecting artisanal and industrial fisherman catches and resulting in strong economic losses and an increased unemployment rate. Furthermore, artisanal fishers, with small boats, limited fishing areas and few alternatives, will bear relatively greater socioeconomic impacts than industrial fishers with their larger and more mobile boats and greater access to financial capital and substitute fisheries (Brander, 2007; FAO, 2009; Grafton, 2010).

Through the development of science-based information that will guide policies and management in the ecosystem and the deployment and operationalization of an effective surveillance system that will support fisheries management, the project will contribute to a better understanding of the potential impacts of climate change on the ecosystem productivity and habitat distribution for marine resources along the coast as well as to improving the capacity to predict short-term events and long-term changes in the coastal-marine ecosystem triggered by climate change.

Furthermore, by strengthening institutions and governance at sector and local levels the project will provide environmental benefits to fishers by contributing to guarantee the sustainability of fishing practices under a highly variable climate system. Moreover, the project will contribute to the improvement of the adaptive capacity of vulnerable coastal communities to climate change by performing specific interventions in the pilot areas.

Additionally, through the development of a framework that will facilitate capacity building and the dissemination of project's lessons learned, the project will improve the availability to generate and interpret data and information on the potential impacts of climate change on marine ecosystems, and this will help to better identify long-term adaptation measures.

C. Describe or provide an analysis of the cost-effectiveness of the proposed project / programme.

As already indicated the Adaptation to the Impacts of Climate Change on Peru's Coastal Marine Ecosystem and Fisheries applies the concept of piloting community based ecosystem management for artisanal fishermen through the introduction of "areas of exploitation" in the regulation. These areas of exploitation are well defined coastal marine zones upon which the government agrees giving the community the rights for an exclusive use of the marine natural resources and creates the incentives for the community to manage their area in a sustainable manner. To do this the government will also provide training, knowledge and accurate information as well as the implementation of tangible and very specific adaptation measures, selected from the list of good practices recommended by FAO and complementary interventions to provide alternative sources of employment and income to the fishermen community (for example eco-tourism activities). These no-regret activities will be complemented with actions to enhance the enabling environment (working with local governments in developing land use plans compatible with and reinforcing the long-term sustainability of the productivity of the coastal marine ecosystem.) Furthermore, the Project includes activities to monitor the ecosystems, their productivity and the wellbeing of the fishermen community to provide feedback to the day to day operation as well as to secure that lessons learned are identified and used by local and national government in guiding further policy development and facilitating the scaling up of similar interventions.

The Cost effectiveness argument for this integrated approach runs a two prone track. On one hand each individual investment will be tested to produce benefits greater than the costs, while the overall program of activities is a pilot at selected sites from which the GOP could learn on the effectiveness and sustainability of empowering local communities to manage coastal marine ecosystems sustainably. Community management will be flexible to the input from science and the information collected through the monitoring system, creating an adaptive management environment to incorporate and cope with the impacts of climate change.

Pilot interventions are proven approaches through which governments experiment complex management options, collect information and lessons learned before embarking in scaling-up (large investment) the initiative. This is a sound and effective way to explore new policy and management options without risking large volume of resources. The approach selected is therefore cost effective.

As indicated, each single adaptation measure will be selected only if it proves to be financially viable. Although at this time there are only preliminary cost benefit analyses for the proposed adaptation measures, the GOP has indicated the need for each individual measure to demonstrate that benefits generated are greater than the costs incurred. Two examples are presented as example of the cost benefit analysis expected by the GOP.

Sustainable fishing and marine certification

From the economic assessment point of view this intervention seeks to introduce sustainable fishing practices and promotion of environmental friendly fishing gears (lift nets) combined with the promotion of a fishery certification process for the artisanal fisheries of selected species, following the Marine Stewardship Council overarching principles, thus opening the access to high-value markets for local artisanal fishermen.

The cost structure of this intervention (defined for each site, but presented here in general terms) includes: Cost of friendly fishing gears for each boat in the program; costs of installation of the new gears in the existing fleet; maintenance and operation costs; reduction of cargo space due to refrigeration needs (as required for certification) implying a reduction in potential catch volume; training costs; certification costs and incidental expenses such as developing business plans and strengthening community leaders to proactively participate in the development of coastal marine ecosystem management plans.

Benefits are associated with changes in marine activities and the higher value of the catch. For example the price of anchovy for fish meal and oil production is around S\$ 560/ton, while the anchovy catch with improved environmentally sound gears is used for direct human consumption and has a market value, at landing, of S\$ 1,866/ton..In the case of yellow fin tuna the price difference is from S\$ 6,000/ton to S\$ 32,900/ton. These high values are only achievable if the fleet is internationally certified following the principle defined by FAO and adopted by the Marine Stewardship Council.

The resulting stream of costs and revenues are calculated based on historical landing statistics and costs figures found in field surveys in each site of interest. The comparison between the costs and revenues stream for a period of 10 years with and without project was calculated. Results are summarized in Table 9. As shown, this no-regret investment has a high rate of return on investment, which a condition for its long term sustainability. The investment required is, nonetheless, beyond the financial capabilities of the individual artisanal fisherman. As a financially viable measure this activity will contribute to improved environmental management in the coastal marine ecosystem, create awareness on environmental management and climate change impacts, strengthen quality control activities and contribute to community management of their fishing grounds. This activity will also benefit from the flow of information from component 2 even if such considerations have not been included in this preliminary benefit and costs analysis. (Detailed analyses are in the project files and are available upon request.)

Promotion of Eco-tourism Activities

Eco-tourism is a site specific activity and a function of the available natural resources upon which the activity could be anchored. Ecotourism as a global industry is growing at rates near 20% per year, as more people become aware of the beauty of nature and the importance of ecological preservation for future generations. The ecotourism specific activities were identified for each cove taking into account their characteristics. In general the proposed activities are summarized in boat trips with the purpose of: touring and sightseeing; fishing with different gears; wildlife sighting (whales and other cetaceans). Although many complementary activities are included in the ecotourism business (food and

drink services, handcrafts, clothing, etc.) the economic analysis is centered only in the boat rides component.

The cost structure of this no-regret activity includes all the cost associated with the design, construction and maintenance of a wharf exclusively for tourist activities, with enough space to allow for complementary activities to develop. In addition costs have been estimated for training, improvement of boats, implementation of adequate safety measures and gears, and operational and administrative costs associated with the activity.

Table 10: Sustainable Fishing and marine Certification: Benefits and cost for Mancora pilot site

INVERSIONES ZONA MANCORA											
Year	0	1	2	3	4	5	6	7	8	9	10
INVERSIONES	3,981,717.3										
BENEFICIOS SIN PROYECTO											
INGRESOS VENTA ATUN ALETA AMARILLA FRESCO		1,901,001.4	1,901,001.4	1,901,001.4	1,901,001.4	1,901,001.4	1,901,001.4	1,901,001.4	1,901,001.4	1,901,001.4	1,901,001.4
BENEFICIOS CON PROYECTO											
INGRESOS VENTA ATUN ALETA AMARILLA FRESCO EXPORT.		3,125,864.2	3,125,864.2	3,125,864.2	3,125,864.2	3,125,864.2	3,125,864.2	3,125,864.2	3,125,864.2	3,125,864.2	3,125,864.2
OPERACIÓN SIN PROYECTO											
COMBUSTIBLE		-1,282,883.3	-1,282,883.3	-1,282,883.3	-1,282,883.3	-1,282,883.3	-1,282,883.3	-1,282,883.3	-1,282,883.3	-1,282,883.3	-1,282,883.3
REPOSICION DE ARTE											-2,200,000.0
OPERACIÓN CON PROYECTO											
COMBUSTIBLE		-1,349,004.7	-1,349,004.7	-1,349,004.7	-1,349,004.7	-1,349,004.7	-1,349,004.7	-1,349,004.7	-1,349,004.7	-1,349,004.7	-1,349,004.7
AUDITORIA ANUAL CERTIFICACION					-100,000.0	-100,000.0	-100,000.0	-100,000.0	-100,000.0	-100,000.0	-100,000.0
NUEVA CERTIFICACION									-1,226,000.0		
MANTENIMIENTO SIN PROYECTO											
MANTENIMIENTO DE APAREJOS (CORTINA, CERCO)		-204,100.0	-204,100.0	-204,100.0	-204,100.0	-204,100.0	-204,100.0	-204,100.0	-204,100.0	-204,100.0	-204,100.0
MANTENIMIENTO CON PROYECTO											
MANTENIMIENTO DE APAREJOS (ESPINEL, PINTA)		-54,000.0	-54,000.0	-54,000.0	-54,000.0	-54,000.0	-54,000.0	-54,000.0	-54,000.0	-54,000.0	-54,000.0
FLUJO NETO INCREMENTAL	-3,981,717.3	1,308,841.3	1,308,841.3	1,308,841.3	1,208,841.3	1,208,841.3	1,208,841.3	1,208,841.3	-17,158.7	1,208,841.3	3,408,841.3
VPN	S/3,971,031.52										
IRR	30%										

Table 11: Eco-tourism activities in Mancora

MANCORA tourism pilot											
Year	0	1	2	3	4	5	6	7	8	9	10
INVERSION	1,616,957										
COSTO OPERACIÓN		64,877	64,877	64,877	64,877	64,877	64,877	64,877	64,877	64,877	64,877
COSTO MANTENIMIENTO		18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600
Tourism development growth (percentage of effective demand)		0.2	0.4	0.6	0.8	0.9	0.9	1	1	1	1
BENEFICIOS		142,730	285,460	428,189	570,919	642,284	642,284	713,649	713,649	713,649	713,649
FLUJO NETO	-1,616,957	59,253	201,983	344,713	487,443	558,807	558,807	630,172	630,172	630,172	630,172
NPV	985,734.2										
IRR	20%										

Revenues were estimated for each type of activity (at least three types of boat rides) and demand forecasts are based on the analysis of tourism surveys and studies conducted by PROMPERU and local universities. Costs per ride are taken from tariffs use in locations with similar characteristics in or near the pilot sites. Moreover, a simple progression was used for estimating the capture of the potential demand from tourists, with an initial attraction factor of 20% growing to 90% by year 5 and 100% by year 7. A 10 year horizon was used in the benefit costs analysis. The economic analysis also includes an estimate of the additional resources the tourists expend in the community for complementary services, some of which might be capture by the fishing community.

Table 10 summarizes the economic analysis, based on a potential demand of only 536 boat trips and a fleet of 8 boats to serve these tourists (12 per ride). The activity shows a very good return on investment (around 20%) confirming the potential to generate additional income and employment opportunities for the artisanal fishing community. This activity will also contribute to create awareness on environmental issues, the need for sustainable exploitation of coastal marine ecosystems, enhance the use of scientific information and strengthen the exclusivity characteristic of the community based management of their fishing grounds. (More detailed information is available upon request).

- D.** Describe how the project/ programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

The proposed project is fully aligned with at least five from the eight recently proposed strategic objectives of the fisheries sector developed by the new government (Ministerio de la Producción, 2012):

- Contribute to growing food security, consumption of abundant fishery resources in highlands and zones of extreme poverty.
- Manage and develop competitively aquaculture activity.
- Manage and develop competitively artisanal fishery.
- Accomplish sustainable fisheries based on the best scientific information of hydrobiological resources, and following an ecosystem approach
- Strengthen the ordination of the fishing and aquaculture activities withn ecosystem approach

Several of these objectives aim for the transformation of the sector through the adoption of policies focused on the development of artisanal fisheries according to an ecosystem approach to fisheries which will make them more resilient to future climate variability and change. For example, for achieving the objective to develop competitively the artisanal fishery, some of the selected strategies are to improve the levels of formalization of the artisanal fishing community and to promote the strengthening of the organization of the fishing associations, cooperatives and small enterprises. For aquaculture, the strategies include the support of a diversified and environmental sustainable activity, as well as to encourage the research, development, adaptation and technological transfer. For sustainable fisheries, a program will be developed for risk assessments, prevention and mitigation of the impacts by natural disasters, El Niño and climate change, over fisheries and aquaculture (Ministerio de la Producción, 2012).

Project adaptation measures such as ecologically-friendly gears, fishery certification, aquaculture and resources co-management will contribute to achieve food security and sustainable fisheries.

The project will provide the scientific basis and strategic guidance for the development of the recently proposed guidelines for the fisheries sector developed by the new government. These guidelines aim for the transformation of the sector through the adoption of policies focused on the development of artisanal fisheries according to an ecosystem-based-management approach which will make them more resilient to future climate variability and change. As part of such orientation, management documents such as the Fisheries Sector Strategic Plan, the National Artisanal Fisheries Plan and the National Aquaculture Plan 2010-2021 propose climate adaptation mainstreaming as a priority action in their environmental sustainability components.

The project is also aligned with the National Environmental Policy, the National Environmental Action Plan 2010-2021 and the results and conclusions of the Second National Communication to the UNFCCC, the three of them having identified marine and coastal ecosystems as well as local communities as a priority in the country's adaptation agenda due to their high vulnerability level to future climate change impacts. In this regard the proposed project, through the implementation of key adaptation measures will help coastal communities of Huacho and Mancora improve their coping capacity to climate change impacts. In general terms, the group of measures can be classified in three types, as follows: (i) expansion of improved fishing practices and promotion of environmental friendly gears; (ii) facilitating the emergence of eco-tourism activities (iii) development of sustainable aquaculture banks in selected areas, (iv) Training to local fishermen. Please see additional details for each site in section A.

Given the importance of the fishmeal and fish oil production in the export sector, the National Strategic Export Plan 2003 - 2013 identified the need for improved management practices in the sector, including the development of capacities of research institutions such as IMARPE. Thus, the proposed project directly responds to this request.

E. Describe how the project meets relevant national technical standards, where applicable.

According to Peruvian law any infrastructure or concession area at sea should have allowance of the Regional Production Agency (DIREPRO) and of the the Authority of Ports and Harbors (DICAPI). If these are built or requested in a Marine Protected Area, then the MPA administration should approve it, besides the allowances mentioned above. The reglament, requirements and license costs are well established. Only if the infrastructure is big enough or the activity is considered as large-scale (over 50 Metric Tonnes/year), an Environmental Impact Assessment is necessary. Activities at sea (fishing, tourism, science) require the permission of DICAPI by routine. Therefore marine monitoring activities should be informed to DICAPI. For meteorological stations, if they are installed in the MPAs, they should be approved before by SERNANP, which is a partner for this proposal.

In the case of the project, proposed activities related to extensive aquaculture and stocking/re-stocking of natural banks are considered as minor scale; and, according to the existing regulations an environmental impact declaration (DIA) is required to be submitted to

the DIREPRO. The DIA consists in the description of the environmental effects of the proposed action. Specifically it must include: general background of the project (name, amount of the investment, duration, etc.), location, and project's description (goals, phases, infrastructure, activities, and main emissions, effluents and residues). Upon the evaluation of the DIA, the DIREPRO issues an Environmental Certification, that along other requisites to be approved by the DICAPI, enable to initiate the activity.

Although the project does not conceive carrying out large infrastructure works per se, some of the proposed adaptation measures such as the ecotourism activities (e.g. construction of small docks) and the establishment of "no-take" zones will need the environmental and social assessments or licenses according to national regulations and IDB standard environmental and social safeguards' provisions. The proposed project will have to follow a regular IDB investment project approval track, which requires by default an environmental and social screening to identify potential project's impacts. In the case environmental and social impact studies are required (projects' categories B and C), IDB safeguards unit will provide to the project team required technical counseling and supervision for the development of said environmental and social assessments.

This proposal has been prepared in accordance with the guidelines provided by the National Strategy for Climate Change (2003), the National Environmental Policy (2009), the Environmental National Action Plan (2010), the Action Plan for Adaptation and Mitigation of Climate Change (2010) and the Scientific Research Agenda for Climate Change (2009). In addition, the proposal activities will be performed under the legal framework established by the Supreme Decree (DS. 02-2008-MINAM) about the water quality standards in marine areas.

Project activities are in line with the legal framework of the "General Law on Fisheries" (Ley General de Pesca) which states that fishing management systems should conciliate the principle of sustainability in order to obtain social and economic benefits (article 10). Specific regulations on certain fish stocks will be considered. Currently legal ordinances for seven fisheries exist:

Giant squid – D.S N° 013-2001-PE

Tunas and species alike – D.S N° 14-2001-PE

Mackerel and Jack Mackerel – D.S N° 24-2001-PE

Patagonian toothfish (*Dissostichus eleginoides*) – R.M N° 236-2001-PE

Hake – D.S N° 016-2003-PRODUCE

Anchovy (only for direct human consumption) – D.S. N° 010-2010-PRODUCE

Common snake eel – D.S. N° 013-2011-PRODUCE

Project activities will strengthen the current system for the management of anchovy stocks based on individual quota per vessel (Maximum Catch Limits per Vessel, MCLV, established in 2009), by improving the quality of the system, and by incorporating climate change considerations in its calculation process. It is important to mention that to date, the results of the MCLV have alleviated the fishing pressure on anchovy, by: (i) longer fishing seasons, which went from around 40 days to more than 100 days a year, (ii) reduced daily captures, from 97,087 to 33,866 metric tons, and (iii) less vessels fishing at the same time, from 1,200 to around 500.

The project promotes environmental awareness as an adaptation measure to increase the resilience of the marine coastal environment. Since 1994, Peru has gone through important steps in the environmental agenda, as productive sectors such as mining, energy and

fishery have generated legislation to mitigate, protect and recover the environment. The creation of the National Environmental Council was fundamental for the interinstitutional environmental work; also environmental units were created in the Ministries and interactions among them were initiated. A multidisciplinary and transversal work between governmental institutions and non-governmental organizations was carried out in the technical Working Group for the establishment of Water Quality Standards (GESTA AGUA). After several years of discussions the Supreme Decree 02-2008-MINAM approved the water quality standards for different uses including productive sectors. The fishery sector, in order to accomplish the water quality standards, had to establish maximum allowable limits for the fishmeal industry, through the Supreme Decree N°010-2008-PRODUCE, based on technical research of IMARPE. These standards will be taken into consideration and reinforced by the proposed project.

F. Describe if there is duplication of project / programme with other funding sources, if any.

Activities included in this project, especially those related to early-warning systems and response, have no duplication with other existing or planned programs or projects, but highly complement other interventions currently implemented or designed by the Peruvian government:

- 1) Towards Ecosystem Management of the Humboldt Current Large Marine Ecosystem (HCLME, 2011-2015): It's a regional Global Environmental Facility (GEF)-funded project, implemented by the United Nations Development Programme (UNDP) in close coordination with IMARPE in Peru and the Instituto de Fomento Pesquero (IFOP, by its Spanish acronym) of Chile. The Project's completion date is July 2013. There is no overlap, but complementarity, between the GEF-HCLME funded project and the AF funded proposal, as shown in Table 12. The main target of the GEF-HCLME is the protection of biodiversity and strengthening of marine protected areas, while the proposed project aims to increase adaptive capacity and resilience of artisanal fishing communities and associated coastal ecosystems, complementing the GEF-HCLME project through the following activities: i) pilot areas chosen based on social and resources vulnerability to climate change criteria; ii) support of the science-based decision-making related to climate change adaptation (e.g. climatic surveillance and prediction) and capacity building in these issues; and iii) specific emphasis on the integration of artisanal fisheries into the regulatory system.

Table 12. Complementarity between the AF proposal and the GEF-HCLME project.

	GEF-HCLME project	AF proposal
Main target/beneficiary	Protection of biodiversity and strengthening of Marine Protected Areas	Artisanal fishing communities and associated coastal ecosystems.
Ambit	Humboldt Current Large Marine Ecosystem (HCLME)	Peruvian Coastal upwelling ecosystem and Northern Tropical Coastal Ecosystem
Concrete interventions for improving the resilience of coastal communities to	No	Yes

climate change impacts		
Pilot areas	Three marine protected areas: San Juan Point, Ballestas Island and Lobos de Tierra Island.	Two coastal areas where artisanal fishing communities live, namely Máncora, and Huacho.
Ecosystem approach	EBM ¹⁹	EAF ¹⁵ , EBA
Surveillance, early warning and Prediction System	No	Yes

The ambit of the GEF-HCLME is the whole Peru-Chile Humboldt Current Ecosystem, while the AF project is focused to the Peruvian Coastal upwelling ecosystem and the Northern Tropical coastal ecosystem.

The GEF-HCLME project will not implement concrete interventions for adaptation to climate change, but it will coordinate the management of the shared stock of anchovy between Peru and Chile as well as it will develop a legal framework for implementing marine protected areas. The AF proposal will complement this project by applying concrete interventions for climate change adaptation on fishery artisanal communities as main beneficiaries. The general framework implemented by the GEF project will facilitate the concrete interventions on artisanal communities.

The GEF-HCLME project has selected marine protected areas as pilot sites: Cape San Juan, Ballestas Island and Lobos de Tierra Island. The AF proposal targets on artisanal fishing communities living in the north of Peru (Máncora and others) and in the central region (Huacho and others), which are associated to different marine-coastal ecosystems. Climatic surveillance and early warning are not considered in the GEF-HCLME project, but the outputs provided in these issues by the AF proposal will also contribute to the adaptive management along the coast, including the GEF-HCLME pilot areas.

Finally, the GEF-HCLME project uses the Ecosystem based Management (EBM) approach, while the AF proposal will use both the Ecosystem Approach to Fisheries (EAF) which focuses explicitly on the fisheries communities and their harmonization with the ecosystems; and the Ecosystem based Adaptation (EBA) to enhance ecosystem services to adapt to impacts of climate change. It should be stressed, that compared to to the Ecosystem Based Management (EBM) which is area-based, the EAF's paradigm is sector-based and focused on target resource and people. In addition, in the EAF the stakeholders are clearly identified as the fishing communities but opened to other actors, while the EBM considers a much broader, but loosely defined universe of stakeholders. Finally, instead of considering protection of specified areas or habitats as the main measures strategy (EBM), the EAF is based on regulation of human activity inputs (gears, effort, capacity), which can also include 'no take' zones as measures to reduce fishing pressure, or output (removals, quotas) and trade (FAO, 2003).

¹⁹ Ecosystem-Based Management (EBM) is a globally recognized approach for better understanding and managing the interactions between uses and the natural system, and integrating multi-sectoral interests into decision making for the - whole marine ecosystem.

- 2) “Support to the Climate Change Agenda in Peru” is an IADB Policy Based Loan which will be disbursed in three tranches during 2010–2013. The PBL focuses on the (i) development and strengthening of the basic institutional framework for climate change management at national, sector and regional levels, (ii) implementation of a GHG mitigation agenda, and (iii) implementation of an adaptation agenda. This operation includes policy commitments by the General Directorate for Environmental Issues of the Vice-Ministry of Fisheries and by IMARPE, such as the formulation of a national plan for climate change adaptation at the sector level, the development of coastal and oceanic climate change scenarios, the identification and characterization of the major impacts associated with such scenarios and the economic valuation of those impacts. This Policy Based Loan will serve as an important basis for the implementation of the proposed project which will build on the political commitment and generated climate change scenarios.

On the non-profit side, several initiatives are being implemented by national and international organizations such as:

- 1) Climate Change Adaptation and Mitigation in Coastal Zones (ADMICCO): A 2010-2014 regional project, under implementation by a network of NGOs from Chile, Ecuador and Peru and with financial support from the European Commission. The project aims to reduce the negative impact of climate change among poor populations in terrestrial coastal zones, mainly associated to drainage basins of the three countries, and to promote adaptation and mitigation actions in those areas. Activities of the project in Peru are concentrated in two pilot areas: Huaral-Huaura (Huacho province) in the north and Ilo, Mollendo and Camaná in the South, both shared with the present project. The proposed project will build on the experience of this project especially in diversifying income generating activities of poor coastal communities, especially artisanal fishermen. The integration of these communities into the regulatory framework, which will be based on the modeling and monitoring network, is considered as utterly important.
- 2) Towards an ecosystem-based management of the anchovy fisheries in Peru (November 2009 - November 2011): It is a project of the Environmental Sustainability Center of the Cayetano Heredia University (CSA-UPCH) with technical support of the Fisheries Center of the University of British Columbia and IMARPE. It seeks to contribute to an EAF in Peru, by using a model that would integrate existing information (results of IMARPE and university investigations), generating benchmarks on fisheries needed by decision-makers and stakeholders. Nevertheless the CSA-UPCH project is not related to climate change, does not involve adaptation measures or interventions in local areas, and capacity building activities are very limited.
- 3) The Humboldt Current Program: An initiative by The Nature Conservancy (TNC) launched in 2008 and aimed to provide information, tools and know-how to: (i) enable the creation of new marine protected areas and the strengthening of existing ones, and (ii) promote sustainable fishing measures to conserve marine ecosystems and resources. This effort includes a research partnership by IMARPE, TNC, the Sustainable Fisheries Group (SFG) and the University of California Santa Barbara (UCSB) to address sustainable fisheries and marine conservation issues in Peru through improved knowledge of how fish stocks will behave given certain environmental changes other than climate change (e.g. El Niño). Proposed project differs in scope from the TNC project and perfectly complements it by focusing on climate change adaptation

measures involving modeling and monitoring interventions in local areas and improvement of governance systems.

- 4) The International Joint Laboratory 'Dynamics of the Humboldt Current system' (LMI 'DISCOH') is a research program that was launched in 2009 (to be closed in 2013) by a partnership between IRD (French Institute for the Development) and IMARPE. The main objective of the LMI is to study the ocean-atmosphere, biogeochemical and ecological dynamics in the Humboldt Current System off Peru in order to understand and anticipate the effect of intra-seasonal, seasonal, inter-annual, decadal variability and climate change on the dynamics of the coastal ecosystem. Therefore it contributes by providing scientific basis for the implementation of the EAF. From a scientific point of view, the LMI 'DISCOH' complements current ongoing projects between IRD and IMARPE in five working packages: (i) metadata, tools and data analysis methods; (ii) physical forcing; (iii) dynamics of the Oxygen Minimum Zone (OMZ) and productivity at multiple scales; (iv) ecosystem approach to fisheries; and (v) socio-economy and environmental impact of industrial and artisanal fisheries and supply chains. In particular, the LMI aspires to orient part of the scientific activities towards key transversal scientific questions. The proposed project will take advantage from the current training that the LMI DISCOH is providing to the scientific staff of the Modeling Center of IMARPE (e.g. WRF, ROMS, PISCES-2 and OSMOSE models). On the other hand, outputs from the socio-economy working package will feed the bio-economical modeling and also will contribute to the proper identification of technological adaptation measures for fishing gears.

G. If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.

As described in Section II-F this project interacts with and complements a variety of existing and planned programs. Therefore, knowledge management and exchange is of primary importance in order to ensure that activities are not replicated and that generated information and experience will feed into existing programs and provide the basis for future activities. To this end, the planned project will apply a learning and Knowledge Management Strategy (KMS) which will include a fixed knowledge management structure as well as selective dissemination activities to extend lessons learned and raise awareness of the issue at hand.

As part of its KMS, this project will, on one hand disseminate the monitoring products to the local communities and general public, and on the other, promote the creation, dissemination and re-use of key knowledge on climate change impacts on marine-coastal ecosystems and coastal communities' livelihoods and will facilitate a better understanding of its main challenges with the final aim of promoting economic, social and environmental development in the Region.

More specific objectives of the KMS includes the promotion of: (i) up to date knowledge that contribute significantly to the understanding of main ecosystems and local communities' vulnerability drivers; (ii) promoting relevant activities conducive to the dissemination of knowledge in community and ecosystem-based adaptation allowing for improved responses to the most pressing challenges posed by climate change to the region; and (iii) the coordination between the various actors of the project in such a way that the generation and dissemination of knowledge activities are developed and implemented in line with their initiatives and actions.

How will the KMS add value to the Project's effort?

- Providing with the right information/knowledge to local communities on ways to address climate change issues, at the right time, increasing their local adaptive capacity;
- Collecting and sharing good/best practices and tools;
- Learning from the project successes/failures to design/innovate and improve related actions and programs;
- Facilitating cross-project learning inside the project team, and among countries in the Region;
- Guiding the production of updated and properly packaged knowledge products to its intended audiences;
- Connecting the knowledge demand/needs of the audiences with the knowledge offer/production of the project.

The process leading to the production of the KMS consists of the general steps illustrated in Figure 5 and described as following:

Knowledge must first be **created** within or outside the project scope, until it is ready for distribution to stakeholders. The creation process involves the conversion of tacit knowledge into documented explicit knowledge. The explicit knowledge created should be easily understood outside its linguistic, organizational and cultural context. It should facilitate the transfer of this newly categorized knowledge into a form that will be of use to groups beyond the creators of the knowledge.

Once created, knowledge should be **validated** to ensure the highest level of quality. This process will involve project specialists, external experts from universities, centers of excellence or development practitioners.



Figure 5. Proposed project KMS under a “user needs” perspective

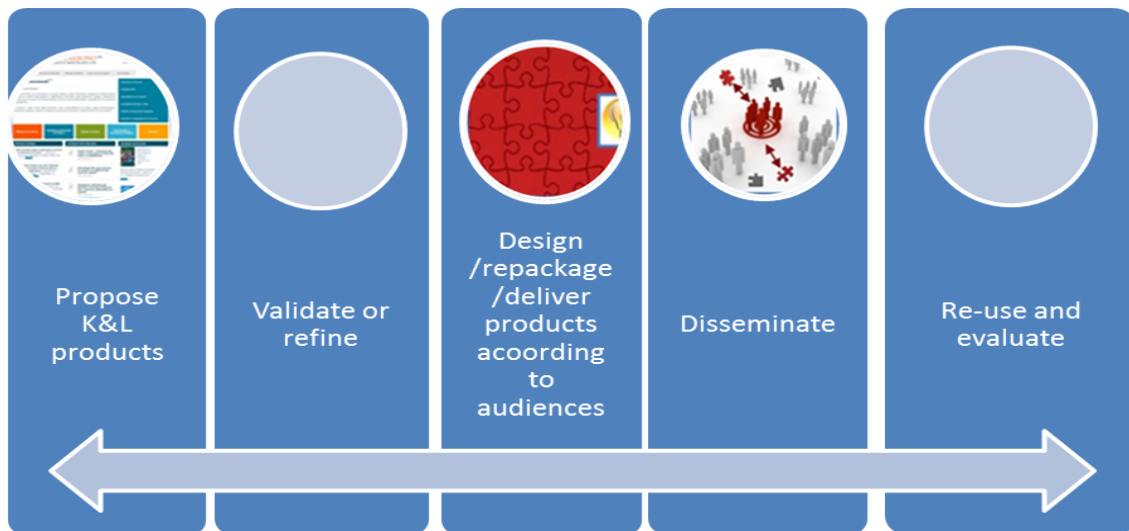


Figure 6. Proposed project KMS building process

For the project, knowledge is an essential factor in developing innovation capacity, and its capacity to identify risks on a timely basis and to take steps to mitigate them. Development effectiveness and results-driven programming require that decisions be based on information, evidence, and knowledge on impacts, outputs, and performance.²⁰ In this context, knowledge needs to be **organized and stored**, but also renewed and brought up to date continuously, so they do not become obsolete or irrelevant.

²⁰ Inter-American Development Bank, IDB. Institutional Knowledge and Learning Strategy Proposal (2008-2010). April, 2008, Washington DC.

The objective of dissemination is to publicize the existence of new knowledge in order to promote its reuse. The method and format of dissemination depends on the audience and their needs. In some cases, the knowledge needs to be adapted from its original form.

Re-use is the process by which knowledge is applied in other experiences and / or contexts. It requires a major effort to ensure that this knowledge will be accessible to interested users. It also needs systematic documentation to ensure a demonstration effect. The re-use will ensure the achievement of the project's goal of contributing to the improvement of development results.

The Project will issue technical documents for decision-makers and stakeholders on governance, EBM/EAF implementation in the policies, and progress in monitoring key bi-physical variables. Two workshops will be organized, one at the project start, and the other one near its end, each at the two different pilot areas. The workshops will involve scientists, stakeholders and decision-makers (local and national) associated to this project and also to other ongoing initiatives, in order to promote synergies, exchange of information and knowledge, and also planning for new projects and/or upscaling successful pilot experiences at national level. Furthermore, a digital network of information exchange and discussion about climate change vulnerability and adaptation will be supported, through an internet website developed by the project.

The project will also organize awareness raising campaigns in regular intervals during and after the project directed to the public and especially regions and social groups which livelihoods are primarily impacted by climate change. The objective of the awareness raising campaigns is to extend information on the value of proper management of marine resources and impacts of climate change to the local communities in order to promote support/participation in the program activities. The target audiences include (i) fishermen, (ii) eco-tourism operators, (iii) coastal communities, (iv) private sector, and (v) students. The campaigns will include the following activities: Seminars and public debates for fishermen and the local communities, meetings with local authorities, associations of artisanal fishermen and other local stakeholders as well as lectures and other educational activities for local schools (e.g. knowledge and artistic contests and announcement of awards for students). Furthermore, the campaigns will include the distribution of booklets and flyers, broadcasting of audiovisual information on climate change as well as on adaptation measures, ecosystems and conservation.

A reference center will be set up at IMARPE which will carefully store data, methodologies and lessons learnt from the project and which will be open for visiting scientists interested in climate impacts on marine-coastal areas as well as to other interested parties. A permanent program of dissemination activities in the centre will be maintained, including broadcasting of educative videos and films, lectures and talks by national and international visiting scientists. This open structure will be part of an effort to widely disseminate lessons learnt and the information obtained. The center is planned to also become a reference place for cooperation and exchange between countries affected by the same type of climate impacts.

H. Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation.

Senior government officials, including the staff at the Ministry of Environment, Ministry of Production and Vice-Ministry of Fishery, and at specialized agencies, such as IMARPE, fully support the proposed project.

A consultative workshop with local and national stakeholders took place at IDB headquarters in Lima, on September 22th, 2011. The goal was to present the project and to survey for inputs and suggestions, particularly those related with the adaptation measures at pilot areas. For this, seven to nine persons from each pilot area were invited to the workshop, including local fishermen, town mayor's representative, and other local authorities. From the government there were invited several directors from the Vice-Ministry of Fishery and from the Ministry of Environment. Also, experts from universities and science institutions (Peruvian Geophysical Institute and the Peruvian Meteorological Service), and a number of NGO's that are involved in other initiatives related to climate change and marine conservation issues participated in the meeting.

In addition, various interviews were carried out at each pilot site, from March 6 to March 11 in the fishing coves of the Mancora pilot area, and from March 22 to April 9th in the coves of the Huacho pilot area. The goal was to collect first-hand information from local communities, authorities, academia, NGO's and regulatory agencies, on potential adaptation measures they could identify that would help them cope with climate observed and anticipated impacts on natural resources (fish stocks), a big contributor to their livelihoods. At the same time interviews were very helpful to better identify main actors and potential champions during project execution phase within local communities. A map of actors was generated together with summaries of issues raised by the communities that include also the identification of external factors outside of climate change that could be of threat to the success of the project. These reports are available in the project preparation files.

The consultation workshop of the Mancora pilot area took place in Mancora town in March 10th, with the participation of representatives of the local and regional governments, the official from the local IMARPE station, including the Production and Environmental Regional Agencies, as well as with the participation of fishermen associations from each cove. For the Huacho area, the workshop occurred in March 23rd, at the Huaura provincial government auditory. Here also representatives of the local and regional governments, fishermen associations from each cove, IMARPE local station participated, but as well, there was a group of professors from the local University (Universidad Nacional José Faustino Sánchez Carrión).

Results from the interviews and workshops contributed to the elaboration of the intervention proposals, as well as to map the risks and strengths for the sustainability of the adaptation measures.

I. Provide justification for funding requested, focusing on the full cost of adaptation reasoning.

Justification for full funding is divided into two elements. First the importance of the project is highlighted, as part of the GOP priorities associated with climate change, adaptation and economic development. The second element discusses the logical framework for the project design. It is argued that all activities are integrated (and are necessary) and linked to produce an adaptation program that gives due attention to climate, climate monitoring and its impact on the primary productivity of the Peruvian coastal marine ecosystems and fisheries, while at the same time support policy definition and management decisions towards a sustainable and productive utilization of the most productive fishing ground in the world.

Background: Expected climate change impacts on fisheries

As has been indicated previously, there is mounting evidence that climate change and changes in the chemical composition of the atmosphere are changing the physical and chemical characteristics of the oceans. The IPCC in its Fourth Assessment Report devotes an entire chapter of its Climate Change 2007 | The Physical Science Basis, to “Observations: Ocean Climate Change and Sea Level.” It concludes as unequivocal from observations of increases in global average ocean temperatures and widespread changes in ocean salinity, wind patterns, heat waves and the intensity of tropical cyclones. Moreover, changes in ocean biogeochemistry have been observed; including increased total inorganic carbon content, changes in acidity and reductions in oxygen content.

Locally, studies by IMARPE and others (Chávez et al., 2008; Demarcq, 2009; Gutiérrez et al., in press) have verified the presence of these global trends and explored the ecological response to such changes. Their conclusions point to a reduction in primary productivity that leads to a decrease in anchoveta production, which impact the food chain with expected reductions in predators (fish, mammals, and birds) that feed on the anchoveta. The process described is expected to accentuate with further global warming.

The proposed project is in line with the new strategic guidelines (PRODUCE, 2010) that the Government of Peru has outlined for the fisheries sector, with clear emphasis in improving the conservation and management of fish resources, especially at the artisanal and aquaculture segments of the sector, in order to improve the resilience to the impacts of future climate change on marine ecosystems and the resources associated with them. It will also help in the implementation of national and local level policies regarding coastal land-use planning and in the identification and pilot testing of income diversification alternatives for coastal population that will need to leave the fishing activity due to the application of sustainable fish management measures.

A recent study (Libélula, 2011) has calculated the amount of financial resources needed to mainstream climate change adaptation in the freshwater, agriculture and fisheries sectors in Peru, identifying a set of basic adaptation measures and the costs related to their development. In the case of fisheries, the study focused in anchoveta fishing for direct human consumption and aquaculture, finding investment needs reaching to US\$ 678 million and US\$ 175 million, respectively, for the 2010-2030 period.

The following description will provide a more detailed justification for each of the planned adaptation measures.

Component 1 Implementation of interventions in pilot strategic areas for improving the resilience of coastal communities and key marine coastal ecosystems to climate change and variability-induced stress and **Component 2** Deployment of a modern and efficient environment surveillance and prediction system in the marine-coastal ecosystems at regional and local scales supporting fisheries adaptive management under the EAF principles

Baseline (without AF financing):

Component 1. The current problematic of the two pilot strategic areas is described in section A and summarized in Table A1 (Annex I). Vulnerability of coastal communities to climate change in those areas is amplified by other stressors, as fishing practices, pollution and

improper territory use. Current development plans for the fisheries industry in these regions fail to consider climate change as a risk factor.

Component 2. In the recent past the GOP has adopted a quota system associated with greater control on the fleet size but it only covers the industrial fleet, and follows a mono-specific approach and an empirical use of environmental information. On the other hand, there are advances in the knowledge of the resource variability related to climatic conditions, but gaps persist in terms of monitoring cover of circulation changes and downscaling of global warming impacts at the upwelling ecosystem level.

With AF financing:

Component 1. This component aims at conducting the identification, feasibility and implementation of alternative productive options for those displaced by the implementation of the new management strategy in pilot areas selected by the GOP as areas where reallocation of fishermen will be needed. The project aims at developing those options that are found to be environmentally, socially and financially sound. Incentives for early adoption of these opportunities will be studied and developed to facilitate broad acceptance. Also, environmental awareness and environmental education will be promoted in the local communities, as part as a wide range of measures, which are fully described in section A.

Component 2. The GOP, with the scientific advice from IMARPE, is required to define the sustainable quota for each fishing season. Defining this target capture is the core scientific and technical task of the adopted management strategy. This component is aimed at building this capability within Peru. It is envisioned that once the project is implemented the sustainable quotas will be estimated following the EAF framework, through the use of proven and verified ecological models, and utilizing oceanographic and climatologic data from field stations and satellite information properly organized as an indicators' dashboard. The continued collection of field data, including physical, chemical and biological will provide the inputs required to improve the quality of the analysis and the ability to model and project ecosystem behavior, which is not currently possible. The execution of this component would allow for a science based/data based policy and management alternative.

Component 3 Capacity building for implementing the EAF as a means for dealing with the consequences of climate change and to disseminate and inform project's lessons, targeting government officials, academia, stakeholders and local communities and **Component 4** Management policies, regulations and measures promoting the resiliency of coastal ecosystems and local communities to climate change and variability-induced stress as well as other anthropogenic stressors such as pollution, coastal marine infrastructure construction and operations, and exploration and exploitation of oil and gas resources.

Baseline (without AF financing): The GOP has been developing policies and management options for the sustainable use of the natural fisheries resources for many years, but without an integrated governance framework that ensures the application of these policies and disseminates the outputs for the stake-holders and the community. Coordination with other government agencies is poor at best, with limited resources devoted to deal with stressors outside the scope of their legal mandate. Emphasis has been on industrial fishing, with artisanal fisheries receiving less attention due to the smaller volumes of catch and the enormous difficulty for adequate inspection, surveillance and control. Within the context of

climate change, the limited application and enforcement of the GOP management policies increases the vulnerability of the resources, particularly those that support the artisanal fishing. One of the current obstacles is the limited human resources for the generation of science-based information for decision-makers, and also the limited human resources at the managerial level specialized in the EAF and in the climate vulnerability criteria.

With AF financing: Detailed modeling and extensive data collection is not enough to assure a sustainable management of fisheries. The policy and management environment requires equal attention. The GOP is prone to implement EAF in the decision-making process that also includes artisanal fishing. Adaptation measures 3 and 4 therefore focus on the development of a framework to facilitate capacity building, both at scientific and at the managerial levels, with a particular emphasis on the development of policy and regulatory tools as the Ecological Risk Assessment and other EAF methodologies, applied to the industrial and artisanal fisheries. Also, the support that the project will give for the development of the information exchange network with local and national stakeholders, will promote the improvement of the project's lessons, and synergies with other ongoing initiatives. The project also recognizes the need to respond to other stressors or threats to the long-term sustainability of the coastal ecosystems, such as pollution and exploitation of gas and oil. The approach taken is to work with the authorities in charge of land use/territorial planning to support the implementation of existing rules, municipalities need to define detailed land use plans, in consultation with all stakeholders. The project will support such planning processes and will aim at incorporating provisions promoting the long-term sustainability of critical coastal marine ecosystem in the pilot areas.

J. Describe how the sustainability of the project/programme outcomes has been taken into account when designing the project.

As it was explained before in section H, different visits have been made to Huacho and Mancora to meet with the different project's stakeholders and obtain first-hand information on their immediate needs and priorities to facilitate an effective adaptation process. This has allowed the project team to develop a map of actors and better understand main community's climate vulnerability drivers and non-climate threats that could compromise the successful accomplishment of project objectives. Dialogues with local communities have been instrumental to have a better idea of perceived present and future risks of climate change on their livelihoods and initially identified solutions to improve their adaptive capacity. Likewise, project activities have been socialized with officials from the different involved ministries (e.g. production and environment) to ensure their alignment with national priorities for the project areas and ensure long term sustainability.

The main identified actions that need to be enforced during project preparation and execution to guarantee the sustainability of project outcomes are:

- 1) *Ensure access to information and technical assistance to local actors.* The proposed project includes a component that will allow the dissemination of knowledge and lessons learned generated by the project through various tools that include the Internet and workshops. The design of a project knowledge management strategy will allow the identification, organization and prioritization of different types of users and their information needs, including a validation phase.

The combination of investment, training and certification through technical assistance becomes a very attractive program with direct and tangible benefits for local communities that depend on fisheries. For example new investments on environmental friendly fishing gears and aquaculture activities, accompanied by a training program to fishermen followed by a certification represents an approach through which they may have access to new markets and get better prices for their products, while helping to conserve an already stressed natural resource. If this model proves to be as economically successful in practice as the initial cost-benefit analyses have shown, it could be attractive enough for other communities to replicate and maintain even after the project is finished. In this regard the financial help from national or regional government through established fisheries programs connected to the project is a key to guarantee long-term sustainability. This point brings to the following two key factors.

- 2) *Create an enabling environment that allows the **ownership** of the project by local communities.* The proposed project is full attuned to the notion of a plurality of interest. On the one hand, individual aspirations are legitimized through the trend towards specialization in the use of environmental-friendly fishing gears and additional economic activities such as aquaculture and ecotourism. On the other hand, common interest (protecting the environment and fish resources through co-management practices lead by the community) create a sense of cohesion that encompasses the entire community.
- 3) *Ensure the compromise and active involvement of national and regional governments' highest levels.* A solid project implementation unit will help maintain a constant and effective flow of information regarding the accomplishment of project milestones to the different governmental actors such as the Environment and Production ministries as well as regional designated authorities. Long term sustainability of project outcomes is guaranteed as long as these are aligned with current and planned strategies to develop the fishing sector by regional authorities. In this sense the adaptation process presented by the project should build on current national work on fisheries' sustainability and contribute to start building climate resilience within the fishing sector. In addition, the project will support communities and fishermen associations to make use of the consultation mechanisms for the planning of annual budget, in order to get funding support for actions oriented to complement and replicate the project's experiences.

In particular for component 2: *Deployment of a modern and efficient environment surveillance and prediction system*, the following points are to be highlighted in order to guarantee its long-term sustainability:

The Peruvian Institute of Marine Research (IMARPE) has the mission to provide science-based information to the government related to the status of the marine ecosystems, the fishery resources and the oceanographic and environmental conditions off the Peruvian coast. Currently IMARPE is divided in several research departments, oriented to fisheries evaluation and monitoring, aquaculture, environmental quality and oceanography, among others. The research activities matrix of IMARPE includes oceanographic monitoring and modeling, though they are currently limited in frequency, spatial resolution and computing power. In addition, there are several coastal laboratories of IMARPE along the coast. Two of them are located close or within the pilot areas. The Mancora site is under the domain of the Paita coastal laboratory, whereas the Huacho site is studied and monitored by the Huacho coastal laboratory.

IMARPE ensures the sustainability of the climatic surveillance and prediction system, by optimizing the human and material resources from the centralized research platforms and

the coastal laboratories, and also by providing the additional resources needed beyond the project. Thus the improvement of the facilities of the coastal laboratories will be prioritized to sustain the local monitoring tasks. For this, development proposals will be presented for consideration to the regional governments of Piura (Mancora site) and Lima (Huacho site), so that additional funding can be accessed. The capacity building given by the project will be used by IMARPE to expand the data acquisition, the information system and the prediction capacities beyond the project. The weather monitoring stations will be operated in agreement with the National Meteorological Service (SENAMHI), and access to additional funding for the maintenance costs and data sharing will be obtained.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for project / programme implementation. Project management

The project will be implemented through a simple and efficient structure that will facilitate the active participation and coordination of all executing agents. IMARPE, the Institute of the Peruvian Sea, will lead all technical and scientific activities; the Ministry of Production, PRODUCE, will conduct all the economic and policy analyses, and will be responsible for coordination and facilitation with all stakeholders, including the Governments of the Piura and Lima regions for the formulation and implementation of climate change plans of action supportive of the project; the Ministry of the Environment, MINAM, will provide technical guidance in the mainstreaming of the climate change adaptation approach in the activities of all the involved institutions (Figure 18).

The GOP is in the process of selecting an agency to develop as National Implementing Agency, in accordance with the Adaptation Fund guidelines. In support of this process IADB will act as implementing agency - using the MIE modality- during the first phase of the project, while the NIE is certified and ready to manage the project. IADB will provide guidance and support for the certification process, including the required institutional capacity building. The implementing agency will have full responsibility for the overall management of the project and will bear all the financial, monitoring and reporting responsibilities. In addition to its mentoring role and fiduciary responsibilities, IADB will supply the following implementation services to the project through its country office, regional and headquarters networks: support project formulation, and appraisal; thematic and technical capacity building; support with knowledge transfer; policy advisory services; technical and quality assurance; and troubleshooting assistance to the national project staff.

The Management of the project and its multiple activities will be led by a team of selected and experienced professionals, reporting directly to the Science Director of IMARPE, who will report to the Executive Director. This team will work in close coordination with the teams of the coastal laboratories of IMARPE in Paita and Huacho. IMARPE's responsibilities will include: i) technical and scientific lead of the project, including preparation of terms of reference for the procurement of all goods and services; ii) monitor the technical implementation of services and other contracts; iii) compliance with all fiduciary requirements with the Adaptation Fund and IADB, including environment, social development, indigenous people and other safeguards in the management of the project and iv) knowledge dissemination and information exchange with all stakeholders and the public in general, including other units within IMARPE, PRODUCE,

MINAM, universities, other national science institutions, NGOs, CBOs, local governments, as well as associations of artisanal fishers from the local areas.

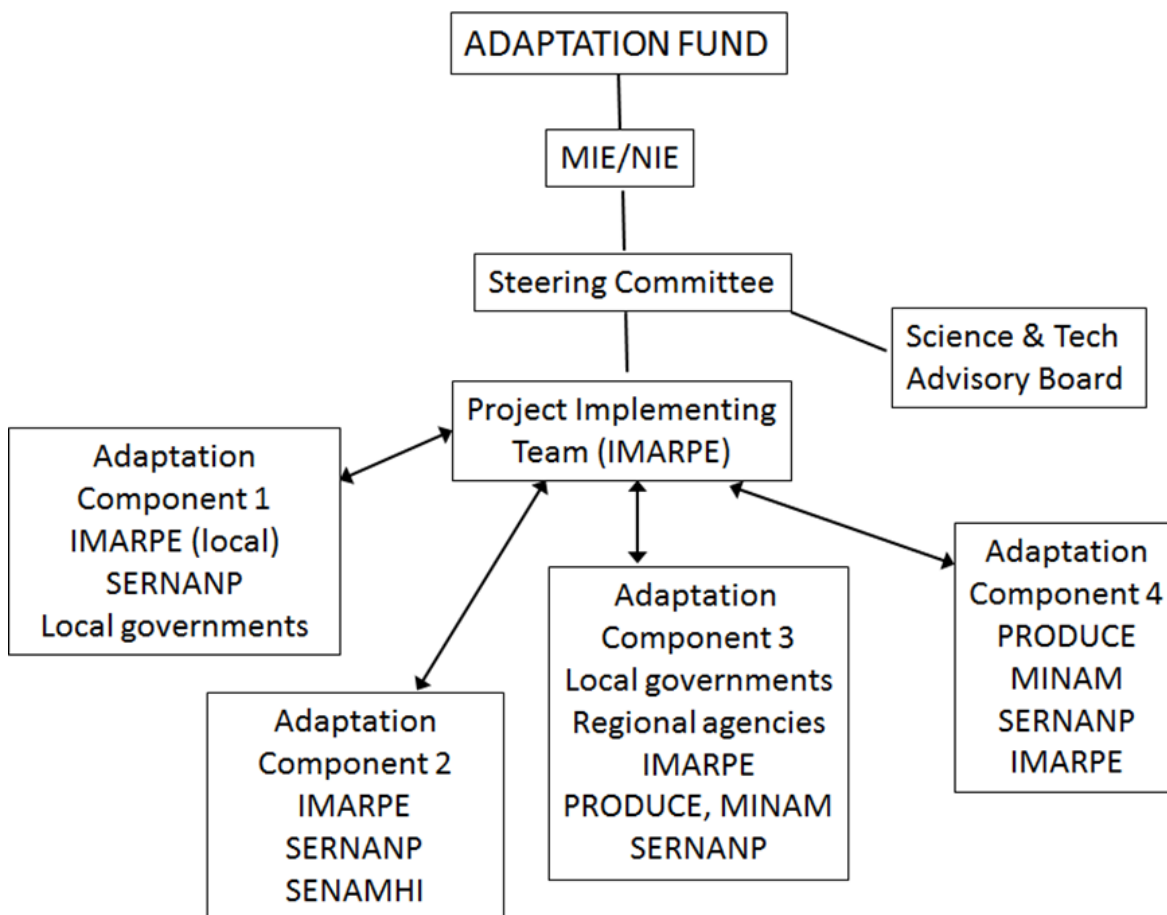


Figure 7. Structure of the project implementation and management.

PRODUCE, through the Vice-Ministry of Fisheries, will be actively involved in the project execution. It will be the main user of the information produced and as such will study, design, develop and implement policies and regulations to foster the sustainable exploitation of the fisheries. The participation of the Vice-Ministry in the present project will be through its General Directorates of Fish Catch (DGEX), Artisanal Fisheries (DGPA), Aquaculture (DGA) and Environmental Affairs (DGAAP).

MINAM guides environmental policy in the country and leads climate change policy and management actions at the national level. It also works with other sectors and sub-national governments developing capacities to deal the complexities and impacts of global warming. MINAM will proactively participate in the Project and support its implementation. In particular, MINAM will support and facilitate coastal land use planning. Coordinating with, supporting and guiding, MINAM will work with the Governments of Piura and Lima in the formulation and implementation of regional-level strategies and action plans for both biodiversity and climate change.

A Steering Committee will be established to provide technical and managerial guidance to the team in charge of the project. Presided by the Vice-Minister of Fisheries and with the participation of IMARPE's Executive Direction, MINAM, academia, local governments and key

stakeholders, the Steering Committee will play a critical role in guiding the project, in providing quality assurance, as well as serve forum for the analysis of policy implications, political feasibility and building consensus for policy and regulation implementation. The Steering Committee will benefit from a Scientific and Technical Advisory Board, integrated with national and international experts, selected in response to the specific needs of the project and needs of the Committee. A core group of two or three scientists/experts will be appointed with regular annual meetings and more frequently if and when required.

The financial administration of the project will be carried out by the Foundation of IMARPE, which recently has been created to channel and manage cooperation funds, ensuring a high efficiency in funds management, reporting and control.

B. Describe the measures for financial and project / programme risk management.

Potential risks for the development of the project are limited and measures to control them have been defined. The following table summarizes identified risks as well as the measures proposed to deal with them.

Table 2. Risks of the project and respective response measure

Risk	Importance	Response measure
Climate change adaptation not within PRODUCE's strategic priorities.	Low	PRODUCE recently presented its new strategic guidelines and climate change adaptation is one of the main lines of action proposed. Additionally, IADB is discussing with PRODUCE in order to advance the formulation of the climate change adaptation strategy for the fisheries subsector.
Scientific and technical information in relation to oceanic climate change, especially at regional and local levels, is insufficient, incomplete, and uncertain.	Medium	IMARPE, the national meteorological agency and other public research institutions are working in the production of information through several on-going projects. The present project will also help in the development of specific information on oceanic climate change.
Limited management and technical capacity related to climate change, particularly in entities at the regional and local levels.	Medium	IMARPE will coordinate with MINAM in order to reinforce training and capacity development activities oriented to regional and local actors.

C. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan.

The Monitoring and Evaluation (M&E) scheme will be conducted in accordance with IADB standard procedures for large scale projects. The project's Monitoring and Evaluation (M&E) plan will allow monitoring progress in achieving outputs, outcomes and the overall project objectives based on the Results Framework. Monitoring activities will seek progress of processes and project milestones completion, while the evaluation will focus on the achievement of results and overall project impact based on the stated objective. An initial M&E budget is presented in Table 13.

Monitoring and evaluation at the project level, including the day-to-day monitoring of project activities, will be the responsibility of the Project Manager, based within IMARPE, with support from the Financial/Administrative Manager assigned for this operation. The Project Manager will liaise with the Ministry of Environment focal point for this project and the IDB, to ensure adequate communication and smooth coordination throughout the execution of the project.

The Steering Committee, presided by the Vice-minister of Fisheries and with the participation of IMARPE's Executive Direction, MINAM, academia, local governments and key stakeholders (as described in section B of Part III) will be part of the project's evaluation activities and will be informed of the progress of the monitoring process. Annual reports, as well as the Mid-Term and Final Evaluations (including lessons learned and good practices) will be presented to the Steering Committee, and disseminated amongst other relevant stakeholders (i.e. government, civil society and participating organizations or beneficiaries).

Resources to be targeted to M&E are represented in a portion of the time of the Project Manager, Administrative/Financial Manager, and components' Technical Coordinators (estimated to demand a dedication of one quarter of the work time). Dissemination of project progress is part of the estimated communication and information dissemination plan. An external financial audit will be performed each year by a firm acceptable to the IDB, which will be contracted by the Executing Agency (IMARPE) and paid for by the project.

Monitoring

Monitoring activities will employ various means of verification, including but not restricted to desk-review of reports, program registry of participating beneficiaries, and market platform VER exchange reports, the consolidated VER registry, amongst others. Information related to product indicators will be collected mainly through documentation and records within institutional actors and stakeholders, as well as through the review of meeting reports, minutes and agreements of the Steering Committee.

The project will have a Project Execution Plan (PEP) to support project management through a multi-year proposal for the execution of the entire project. The PEP is based on the results matrix and includes the activities and responsibilities throughout the project timeframe. A Project Initial Report will include a detailed description of first year's annual work plan, divided in quarterly sections, related budget and progress indicators to guide the project implementation during the first year.

The Project Manager will produce the following annual reports to monitor and evaluate general project progress and the fulfillment of the indicators identified in the Results Framework: (i) a proposed Annual Work Plan (AWP) at the beginning of each year of project execution; (ii) a Mid-Year Progress Report half-way through each year; (iii) an Annual Project Report at the end of each project year; and, (iv) a Project Implementation Review (PIR) in collaboration with the

Bank and to be submitted to the AF via the Bank. The latter will incorporate information needed upon guidance by AF, such as project performance ratings and tracking tools. Within the first 6 months of the project, the Project Manager will also be responsible for consolidating all baseline information required for the indicators identified in the Results Framework

Evaluation

The Mid-term Evaluation, carried out when 40% of the AF resources are disbursed, or 24 months after the project contract goes into effect, whichever comes first, will determine progress towards results' achievement, the level of stakeholder participation, any positive changes in beneficiaries' practices due to the intervention, and will identify necessary changes to be made. This review will principally ascertain if project objectives are in the process of being met by current implementation strategies, based on project component design and execution, and quality of project coordination. The review will address matters such as: (1) an assessment of general project progress and the fulfillment of the indicators identified in the Results Framework; (2) a critical assessment of project administration, coordination and execution; (3) the effectiveness of project and individual component design including progress in inter-institutional coordination and execution. This review will serve as a formative evaluation, meaning that it will be geared towards improving project implementation based on information to date.

In addition to the internally led Comprehensive Participatory Review, an independent external Final Evaluation will be conducted three months before the Steering Committee meets for the last time and will focus on the same areas analyzed in the Mid-term Evaluation. Lastly, the Final Evaluation will also analyze the overall project impact and the sustainability of its results, including its contribution to national and local capacity building efforts and to global environmental goals in the context of adaptation.

Table 13. Preliminary budget of Monitoring and Evaluation

Type of M&E activity	Responsible parties	Budget US\$	Time frame
Kick-off workshop and report	<ul style="list-style-type: none"> • IMARPE, IADB, AF • Steering committee 	15,000	Within first two months of project start up in one of the pilot areas
Measurement of means of verification for Project progress	Steering committee, IADB	-	Annually
Periodic status/progress reports	Project manager (IMARPE)	-	Quarterly/annually
Mid-term evaluation	Project manager and team (IMARPE), IADB, Science Board	12,000	Before 24 months of project start up
Late-term Workshop and report	<ul style="list-style-type: none"> • IMARPE, IADB, AF • Steering committee 	15,000	Nine months before the end of project implementation, in one of the pilot areas
Final Evaluation	Project manager and team (IMARPE), IADB, Science Board, external consultants	30,000	Three months before the end project implementation
Audit	IADB, IMARPE	9,000	Annually

TOTAL		81,000	
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D. Include a results framework for the project proposal, including milestones, targets and indicators.

The project’s proposed results framework is aligned with the *Adaptation Fund Results Framework*²¹ architecture and directly contributes to the overall objective “Reduce vulnerability and increase adaptive capacity to respond to the impacts of climate change, including variability at local and national levels”.

There is perfect alignment between the stated objective of this proposal and the AF **overall objective**. Proposed project’s objective (see Part I, Project Objectives) indicates that it supports the efforts of the Government of Peru (a particularly vulnerable country to the adverse effects of climate change and party to the Kyoto Protocol) reducing the vulnerability of coastal communities to the impacts of climate change on their main source of income, wealth and wellbeing; the coastal marine ecosystems and fisheries resources in Peru. The project is limited to well-defined coastal marine areas to be co-managed with the community of users.

Alignment between the AF Results Framework and the project is also clear at the impact level. The project expected **impact** on the target population (selected pilot coastal fisheries communities) is to increase the resilience at the community level to climate variability and climate change.

In particular the proposed project contributes to the following AF expected results. The proposed project is aligned with the following outcomes (Table 14):

Expected results	Indicators
<p>Outcome 3: Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level <i>Supported by component 3.</i></p>	3.1 Percentage of targeted population aware of predicted adverse impacts of climate change, and of appropriate responses
<p>Outcome 5: Increased ecosystem resilience in response to climate change and variability-induced stress <i>Project contribution: The project logic indicates that increasing the resilience of the local fisheries communities requires to plan and execute actions to foster coastal ecosystem resilience</i></p>	5. Ecosystem services and natural assets maintained or improved under climate change and variability-induced stress
<p>Outcome 6: Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas <i>Project contribution: The project’s strategy is to improve existing fisheries practices</i></p>	6.1 Percentage of households and communities having more secure (increase) access to livelihoods assets

²¹ Results Framework and baseline guidance, project level, Adaptation Fund, 2011

<i>complemented with developing new sources of income and improve the incomes for the target communities.</i>	
<p>Outcome 7: Improved policies and regulations that promote and enforce resilience measures</p> <p><i>Project contribution: Component 4 aims at creating the enabling conditions (governance, policies, regulations, institutional capacity) for the successful implementation of community based management of coastal marine ecosystems</i></p>	7. Climate change priorities are integrated into national development strategy

Table 14. Contribution of the project components to the AF Results Framework.

- E. Include a detailed budget with budget notes, a budget on the Implementing Entity management fee use, and an explanation and a breakdown of the execution costs.

A detailed budget including budget notes on the Implementing Entity management fee including a breakdown of the execution costs will be developed during the preparation of the full project document.

- F. Include a disbursement schedule with time-bound milestones.

A comprehensive disbursement schedule with time-bound milestones will be developed during the preparation of the full project document.

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT²² *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

<p><i>Viviana Grissel Zaldivar Chauca (Advisor); Asesora, Gabinete de asesores de la Alta Dirección, Ministry of Environment (MINAM)</i></p>	<p><i>Date: April 24th, 2012</i></p>
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B. IMPLEMENTING ENTITY CERTIFICATION *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

<p>I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans (e.g. <i>Second National Communication to the UNFCCC, National Strategy for climate change and its Action Plan for mitigation and adaptation, National Environmental Policy</i>) and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.</p>	
<p><i>Name & Signature</i> Implementing Entity Coordinator</p>	
<p><i>Date: (Month, Day, Year)</i></p>	<p><i>Tel. and email:</i></p>
<p><i>Project Contact Person:</i></p>	
<p><i>Tel. And Email:</i></p>	

⁶. Each Party shall designate and communicate to the Secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

ANNEX I Detailed description of pilot areas and planned intervention actions

Description of the pilot areas and proposed adaptation interventions per selected site

The Peruvian coast is affected by two main different climatic and oceanographic systems. The Northern coast is partly under the influence of warm tropical waters and high precipitations on land, whereas the rest of the coast is subject to the cold coastal upwelling waters and arid conditions on the continent (Figure 8). Nevertheless, the southernmost coastal marine area presents a very narrow shelf and is more exposed to the intrusion of oceanic waters with lower productivity. Current trends in coastal SST exhibit significant warming for the Northern coast (<06°S), contrasting with strong cooling from Callao (12°S) to the south (Gutiérrez *et al.*, 2011) (Figure 9). This behavior is also associated with different trends in productivity and possibly subsurface water oxygenation (Demarcq, 2009; Quipúzcoa *et al.*, accepted).

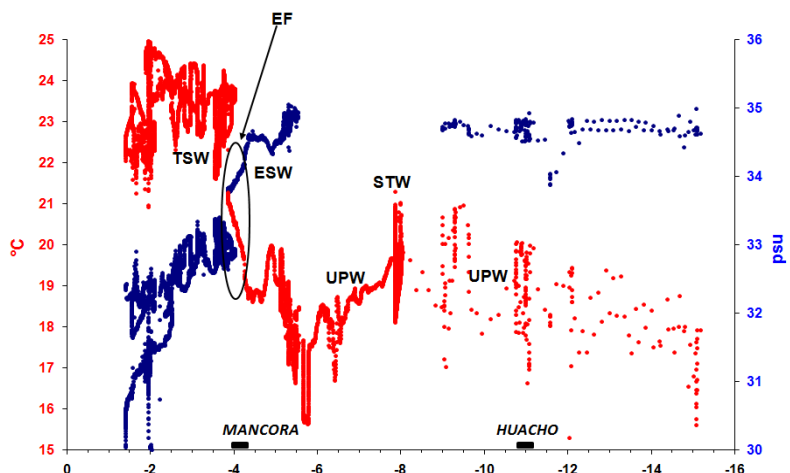


Figure 8. Surface water masses along the Peruvian coast in December 2009, as detected from online hydrographic records onboard the RV Meteor M77-2, about 100 km off the coast (R. Schneider, pers. comm.). The latitudinal positions of Mancora and Huacho are marked. TSW: Tropical Surface Waters, ESW: Equatorial Surface Waters, UPW: Upwelling Waters (also known as Peruvian Coastal Waters):

Taking into account these features, the different adaptation interventions proposed in the coastal zone focus on two representative areas: one at the Northern coast (Mancora, 04°06' – 04°15'S, Piura Region), and one at the Central coast (Huacho, 11°01 – 11°20'S, Lima Region). Huacho is one of the main fishing harbors in the Lima Region, the second in terms of industrial fishery due to the exploitation of the Northern-Central stock of the Peruvian anchovy (*Engraulis ringens*). Mancora is nowadays not a landing point for the industrial fishery, but lies within the main distribution area of hake (*Merluccius gayi peruanus*), which is the main demersal²³ resource off the Peruvian coast.

Adaptation measures to reduce the impact of climate change on natural resources should necessarily address the issue of overfishing in the face of climate change, which will involve measures to reduce current catches. In this context adaptation interventions for the selected sites will promote fishery resource conservation, sustainable fishery management programs and economic alternatives outside fishery harvest.

²³ Describing a fish that lives close to the floor of the sea or a lake (<http://www.thefreedictionary.com/demersal>)

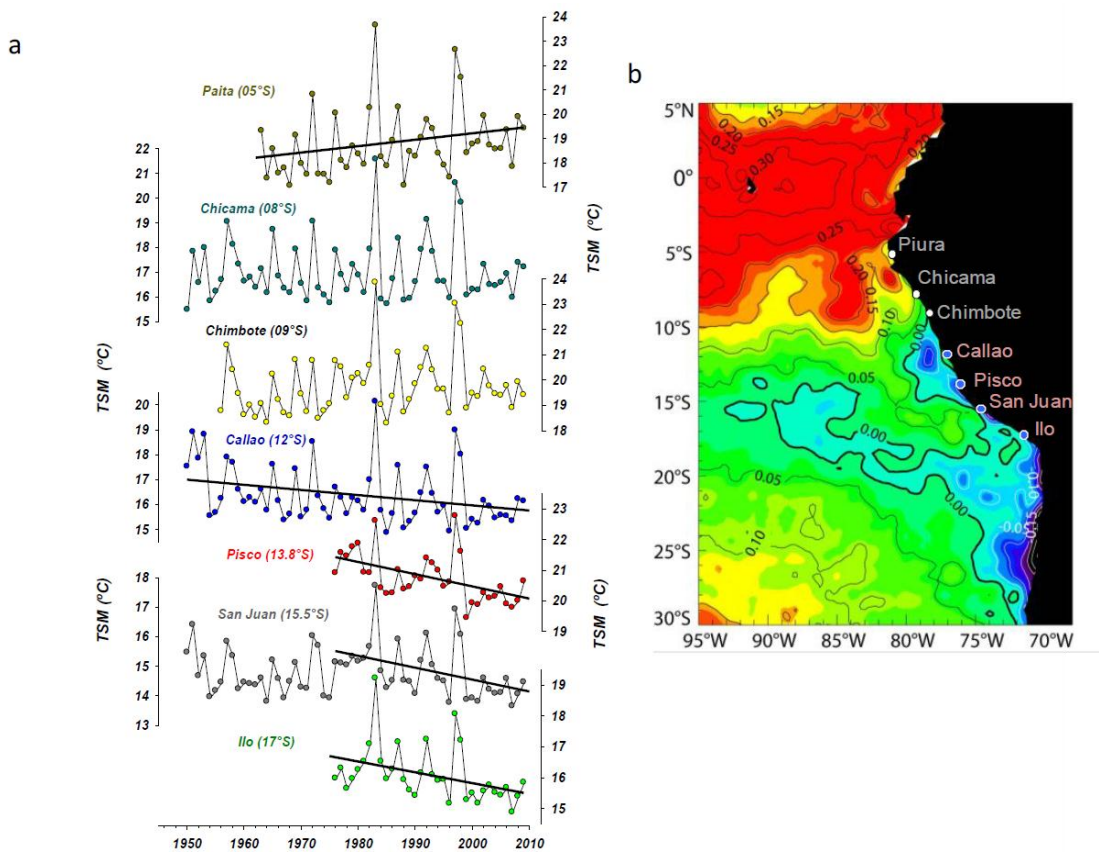


Figure 9. a) Trends in mean annual sea surface temperatures (SST), as measured in piers along the coast. Bold lines indicate statistical significance. For Paíta, trend is $+0.15 \pm 0.10^{\circ}\text{C}$, for Callao, $-0.22 \pm 0.08^{\circ}\text{C decade}^{-1}$; $p=0.01$, for Pisco, $-0.43 \pm 0.13^{\circ}\text{C decade}^{-1}$, $p < 0.01$ (no data before 1976), for San Juan, $-0.42 \pm 0.14^{\circ}\text{C decade}^{-1}$; $p < 0.01$ (since 1976), for Ilo, $-0.18 \pm 0.06^{\circ}\text{C década}^{-1}$; $p < 0.01$; b) Trends in $^{\circ}\text{C/decade}$ for SST since 1984 to 2010 for the region, using the Reynolds database. Modified from Gutiérrez *et al.* (in press).

In addition, participative workshops involving artisanal fishers will be carried out in order to gather information about traditional fishery practices, and to involve the local fishermen in the decision-making process about the fishing gears selected at each pilot area. The sites are characterized in terms of proposed adaptation interventions, specific environmental, socio-economical and fisheries management issues as follows:

Approach for the interventions at pilot sites

The main objective of the interventions is to increase the communities' adaptive capacity at pilot areas based on a better understanding of their conditions and needs matched with a better understanding and monitoring of the ocean's productive capacity. They will be implemented in a highly interactive and participatory process with the coastal communities which apply artisanal fishing techniques. Through a mutual learning process common ground is aimed to be found on activities which will not only ensure long-term sustainability of fish populations but also the social and economic needs of the communities. Adaptation actions to be implemented will be

prioritized with respect to their specific cost/benefit ratio and their strategic contribution towards a long-term artisanal fisheries management system.

In order to improve the current adaptive capacity of these local coastal communities, the adaptation pilots are divided in immediate and second phase actions. At the start of the project, immediate actions, the activities include an intensive consultation and mutual learning process between the coastal communities and the project team, training for the local fishermen and populations, strengthening of climatic and oceanographic monitoring, support of pilot projects on eco-tourism and ‘fishery-tourism’, support of new or ongoing territorial planning projects or policies, and realization of local workshops to discuss the implementation of co-management. In the second fase, the activities comprise the promotion of use of new technologies, eco-labeling and certification, development of aquaculture of native species, support improvement of aquaculture systems, and environmental education in local schools.

Table A1. Summary of vulnerability factors in the two pilot strategic areas.

Factor / Feature	Máncora	Huacho
Key physical forcing	Equatorial Front	Coastal winds
Shelf/upwelling	Narrow/episodic plumes	Wide/wide
Coastal marine habitat	Vulnerability to climatic extremes (floodings, El Niño). Untreatment of waste waters	Subjected to chemical pollution (fisheries, agriculture) and domestic sources. Vulnerability to climatic extremes (El Niño).
Coastal biodiversity	Panamanian province and ecotone to Peruvian province (south), migration route of cetaceans and turtles	Wetlands, islands and inlets; habitats for migratory birds, colonial guano birds and marine mammals
Main resources	Giant Squid, Yellowfin Tuna	Anchovy (Central –Northern stock)
Main artisanal fishery resources; landings rank	Giant Squid, Yellowfin Tuna; 5th	Anchovy, scombrids, coastal fishes; 19th.
Anthropogenic pressure on top predators	Gillnet fishing – cetaceans and turtles	Pressure on habitat areas of marine birds and mammals
Hazards or conflicts in marine coastal management	Territory use/planning and climatic vulnerability and coastal marine pollution	Territory use/planning and coastal marine pollution
Climatic projection hypothesis up to 2030	SST increase in +0.4°C, > probability of extreme precipitations	High degree of uncertainty (either cooling or warming).

Several potential types of concrete interventions have been defined during a joint workshop between IMARPE and members of the communities of both pilot areas. These include: (1) promote the use of environmental-friendly fishing gears, ameliorating the status of the coastal marine resources; (2) reduce by-catch resulting in unintentional mortalities of top-predators, as marine mammals, birds and turtles; reducing the stress of the ecosystem food-chains; (3) promote sustainable aquaculture activities and eco-tourism, where they are environmentally, financially and socially suitable, providing alternate economic activities for artisanal fishers, reducing their vulnerability to climate change effects on their ecosystem; (4) support territorial planning, coastal marine habitats conservation or rehabilitation in agreement with the Ecosystem based Adaptation (EbA) approach (CBD, 2009); (5) promote co-management of benthic resources as a way to apply the Ecosystem Approach of Fisheries (EAF) at micro-scale; and (6) increase awareness of the impacts of climate and extreme events and the need for integrated coastal zone management, for the population and local authorities. These interventions will be further discussed, refined and complemented during a continued consultation process with the communities and throughout the implementation of the project.

1) Máncora, Piura Region, Tropical Coastal Ecosystem

General environmental description

In oceanographic terms, Máncora is located in southern tip of the Tropical Eastern Pacific Coastal Ecosystem, facing the seasonal north-south displacement of the Equatorial Front (EF) (Figure 10), where the Surface Tropical Waters (with high temperatures and low salinities) mix with the waters of moderate temperatures and higher salinities that characterize the HCS. The position of the EF is highly dynamic, exhibiting also interannual shifts in its latitudinal position. In winter, the Máncora area is influenced by the advection of

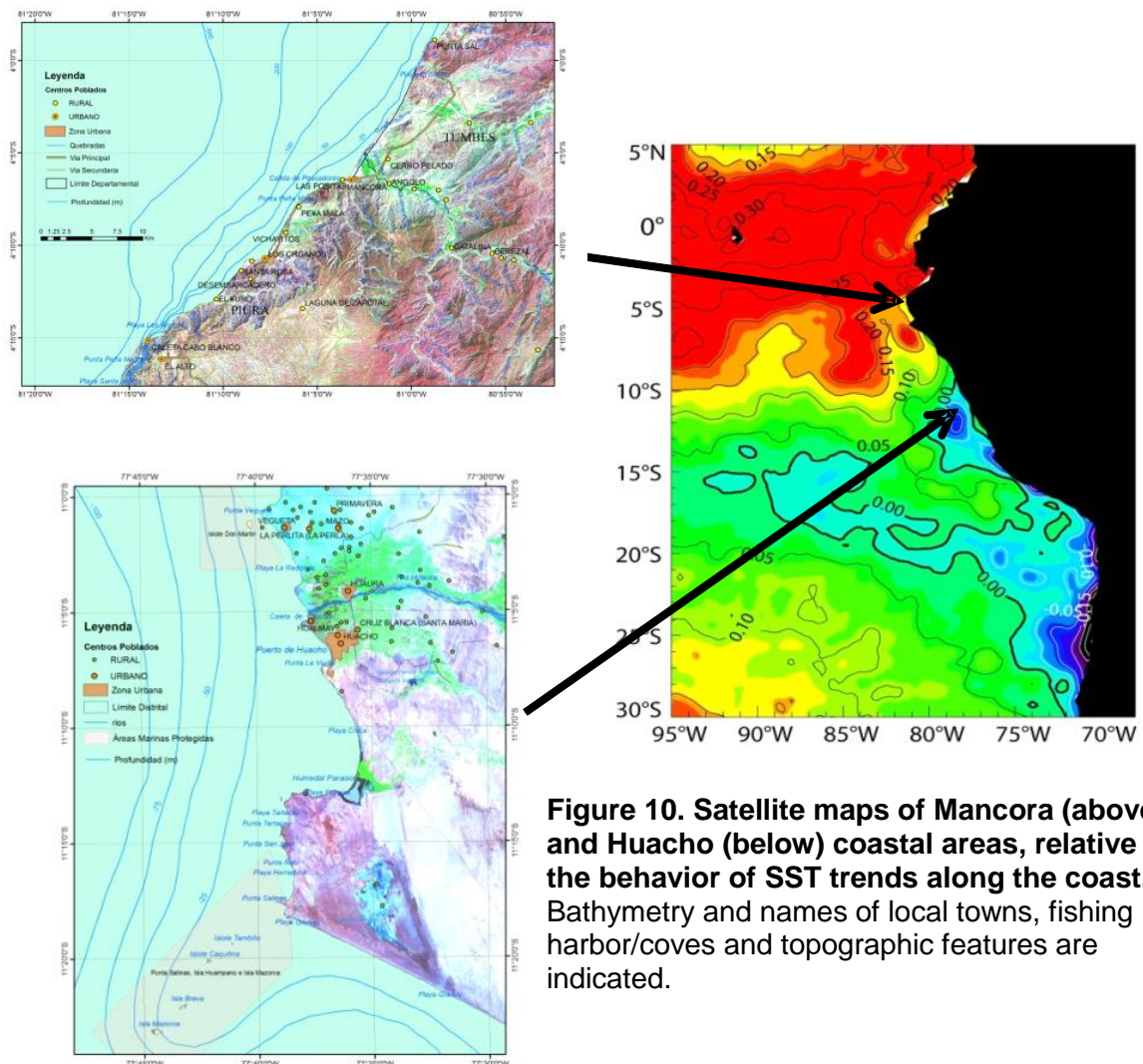


Figure 10. Satellite maps of Mancora (above) and Huacho (below) coastal areas, relative to the behavior of SST trends along the coast. Bathymetry and names of local towns, fishing harbor/coves and topographic features are indicated.

upwelling waters from the south, lowering sea surface temperature values around 19°C, while in summer it is exposed to the advection of the Tropical Surface Waters, reaching 27°C (source: IMARPE, unpub. data).

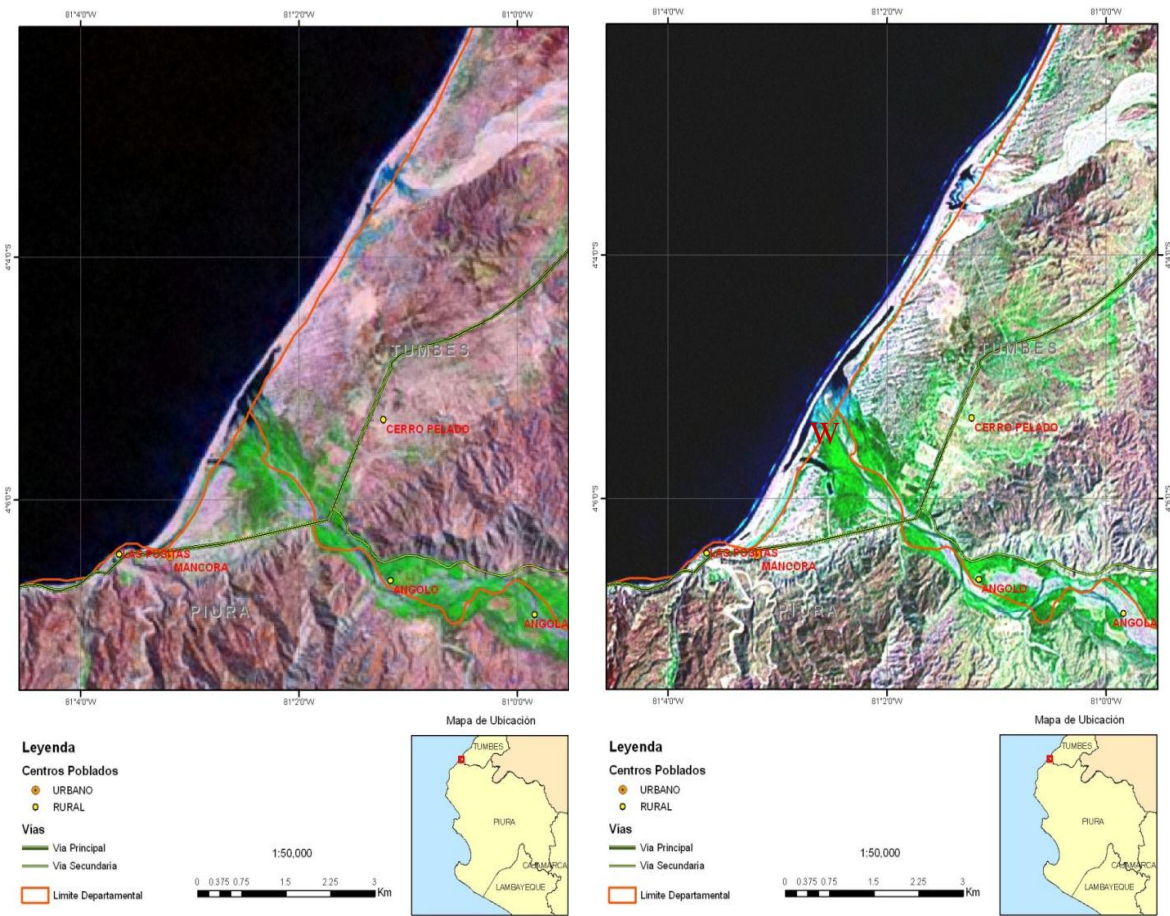


Figure 11. Change in the coastline induced by the 1997-98 El Niño around Mancora. Left: before the El Niño event; Right: after the El Niño event. Wetlands (W) associated to the ravine Quebrada Fernández are marked.

Máncora town is both a seaside resort and a fishing cove in Northern Peru. On land, the Máncora area is cut by several ravines, which are filled in wet periods. The air temperature varies from 17°C to 27°C in the annual cycle, but during El Niño, the air temperature can reach 40°C. According to pluviometric measurements in Talara and in Tumbes, about 60km north and south of Máncora, respectively, mean monthly precipitation values range from 0-7mm (dry season) to 70-470mm (wet season) in the annual cycle, but during the last two extreme El Niño events (1982-83 and 1997-98), precipitation increased in about one order of magnitude during the wet season (Pouyaud *et al.*, 2001), leading to the overflowing of the ravines and to coastal flooding. It is remarkable that in the last extreme EN, the combination of delivery of high amounts of particle material to the ocean and wave-driven sediment transport led to a regression of the shoreline in Máncora (Figure 11). The coastline presents fine sand beaches and wetlands. The sub-tidal sediments are oxidized muddy fine sands with relatively low contents of organic matter (~3%) (Carbajal *et al.*, 2010).

Economic activities and social conditions

According to the National Institute of Statistics (INEI, by its Spanish acronym), the population of Máncora is 10547 persons, and the working people is composed mainly by fishermen (10.3%), car drivers (9.7%), shopkeepers and dealers (9.5%), followed by cooks, hotel personnel and bricklayers (about 5% each). Accordingly, the main economic activities

of Máncora are: fishing, commerce, hotels and restaurants, building and transport. It is remarkable that in the recent years, Máncora has received an increasing number of national and foreign tourists, leading to a rapid construction of more hotels along its coastal line. One of the main social problems of Máncora is the housing sanitary conditions. 76.1% of the houses are connected to the public network of drinking water, and only 58.3% are connected to the public sewer system. On the other hand, 81.3% of the houses have access to electrical current.

Coastal marine zone management issues

A high coastal marine biodiversity characterizes Máncora due to its latitudinal position. The coastline presents wetlands, particularly associated to the mouth of the ravine Quebrada Fernandez (Figure 11), which are poorly studied in terms of their flora and fauna, and the ecological services they provide. The fine sand beaches and the clear coastal waters attract tourism and recreation activities, including scuba diving and dive fishing. The biogeographic and oceanographic conditions sustain an active artisanal fishery oriented to oceanic, coastal and benthic resources²⁴. An issue of concern is the impact of human populations and fishing activities on the habitat of large marine mammals and marine turtles.

Incidental fishing and stranding of whales, dolphins and turtles are frequent in the area, the latter due to injuries caused by gillnets deployed in the fishing areas. Therefore, an adequate management of the territory use, including the coastal marine zone, is still a pending task. Pollution and sanitary problems have not yet been solved for the whole area, though since 2010 the government is developing a project to improve the sewer system and to recover one of the wetlands located just next to Máncora town. Building of hotels and resorts has been very rapid, increasing the pressure on the beaches and coastline, which are otherwise very sensitive to the El Niño-driven fluvial sediment transport and flooding.

Fishery and Landings

The following description is based on previous IMARPE surveys and fisheries database. Nearly all of the fishing activities in Máncora are performed by artisanal vessels, though they exhibit a high diversity of fishing arts and fishing targets, comprising large oceanic fishes, as tunas, sharks and scombrids, smaller pelagic²⁵ fishes, coastal demersal fishes, giant squid and benthic invertebrates. Figure 12a shows the relative contribution of the main nektonic resources to the landings in Máncora. It is remarkable the relatively large contribution of oceanic and coastal demersal fishes to overall landings, as well as the dominance of purse seines, gillnets and hooks (Figure 12b). Long-lines and surface-gillnets (which are included in the gillnet category) are oriented to oceanic fishing, as well as harpoons for sharks and marlins.

In general, the landings are characterized by a large variability in species composition and amount of landings (Figure 13). The top three resources in landing statistics for the past decade were Giant Squid (*Dosidicus gigas*), Pacific Harvestfish (*Peprilus medius*) and Yellowfish Tuna (*Thunnus albacores*), reaching annual catches of about 710t, 610t and 300t, respectively. The landings of Yellowfish Tuna show a tendency to increase in the past decade (Figure 13b). Among the pelagic and coastal nekton, catches of Giant Squid and of Mackerel *Scomber japonicus* are episodic, while catches of Jack Mackerel *Trachurus murphyi* have almost disappeared since 2003 (Figure 13c). Among the coastal demersal

²⁴ The collection of organisms living on or in sea or lake bottoms (<http://www.thefreedictionary.com/benthic>)

²⁵ Relating to or living in or on oceanic waters (<http://www.thefreedictionary.com/pelagic>)

nekton, the catches of Hake (*Merluccius gayi peruanus*) are also episodic, while those of the Common Snake Eel (*Ophichthus pacifici*) exhibit a declining trend.

The landings of Pacific Harvest fish are sustained, but with large fluctuations (Figure 13d). It is worth to mention that the fluctuations of the landings of Yellowfish Tuna are related to ENSO. For instance, higher catches in 2003, 2007 and 2010, followed the moderate El Niño events in the past decade. Finally, benthic invertebrates' landings are mainly composed by Oyster (*Ostrea iridescens*) and Brown Shrimp (*Farfantepenaeus californiensis*). In Peru, the last three El Niños appear to have negatively impacted the landings of Brown Shrimp (Figure 13e).

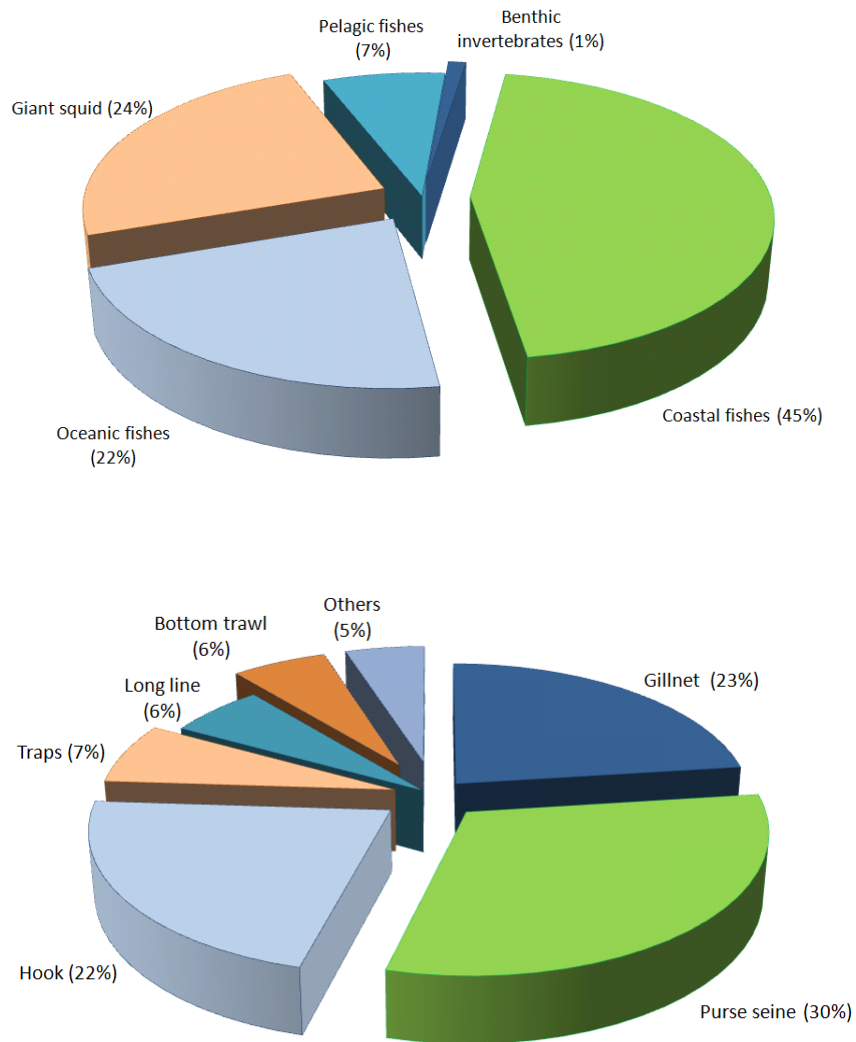


Figure 12. Summary of landing statistics from 2001 to 2010 in Mancora: a) Composition of the landings by fishery resources; **b)** Composition of the landings by fishing arts.

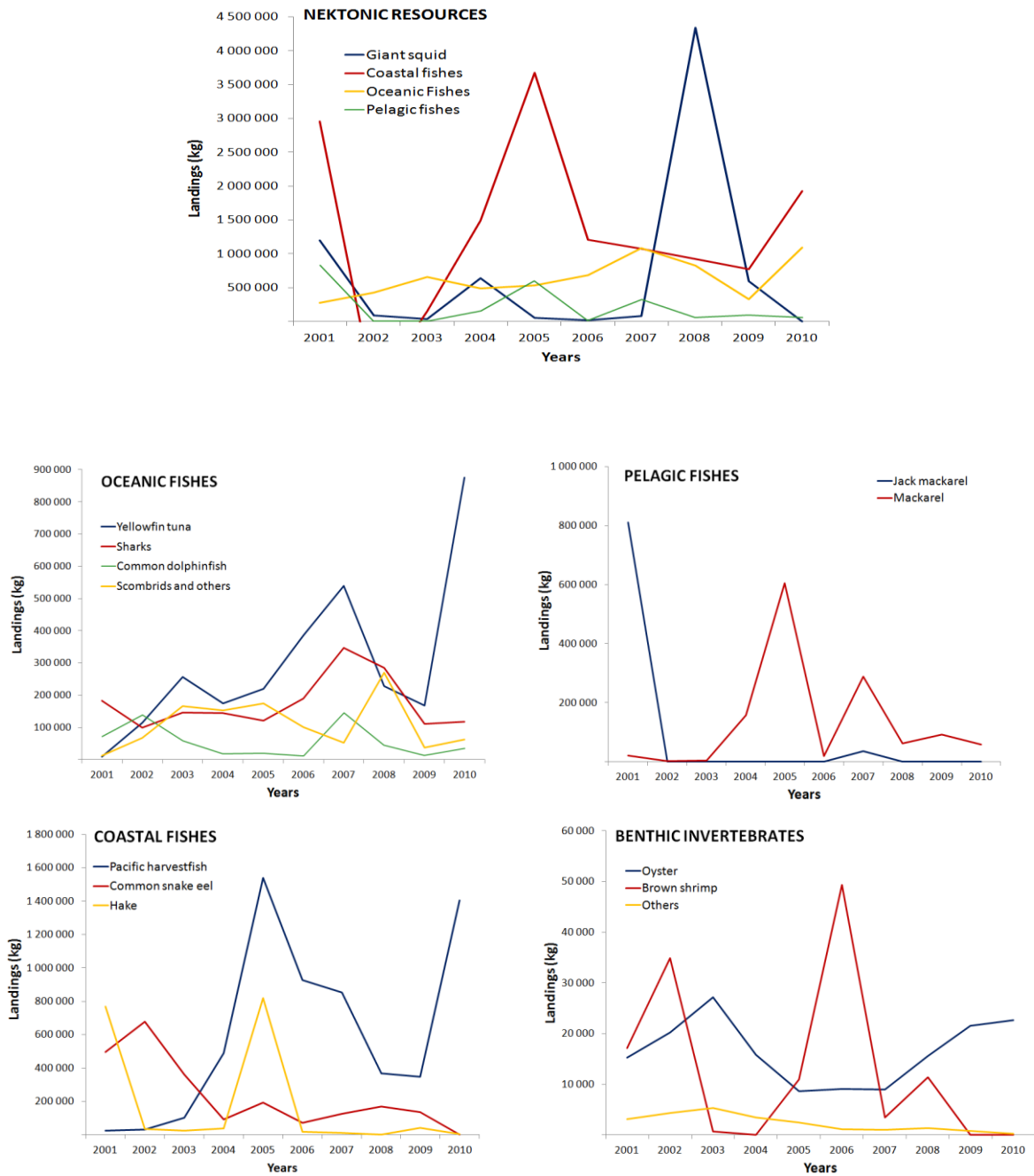


Figure 13. Time-series of the landings (kg) by resource categories in Mancora and their principal species: a) All nektonic resources; b) Oceanic fishes (tuna, sharks, common dolphin fish, scombriids and others); c) Pelagic fishes (jack mackerel and mackerel); d) Coastal fishes (Pacific harvest fish, common snake eel, hake); e) Benthic invertebrates (oyster and brown shrimp).

Banks and fishing grounds

Banks of several benthic resources are present off Máncora and nearby areas. The most important ones are those of the Pearl oyster (*Pteria sterna*), from Máncora to Los Organos, Baby clams (*Donax* spp), mostly just south of Máncora, and Oyster (*Ostrea iridescens*), north of Máncora to Punta Sal (Carbajal *et al.*, 2010; Ordinola *et al.*, 2010). However the

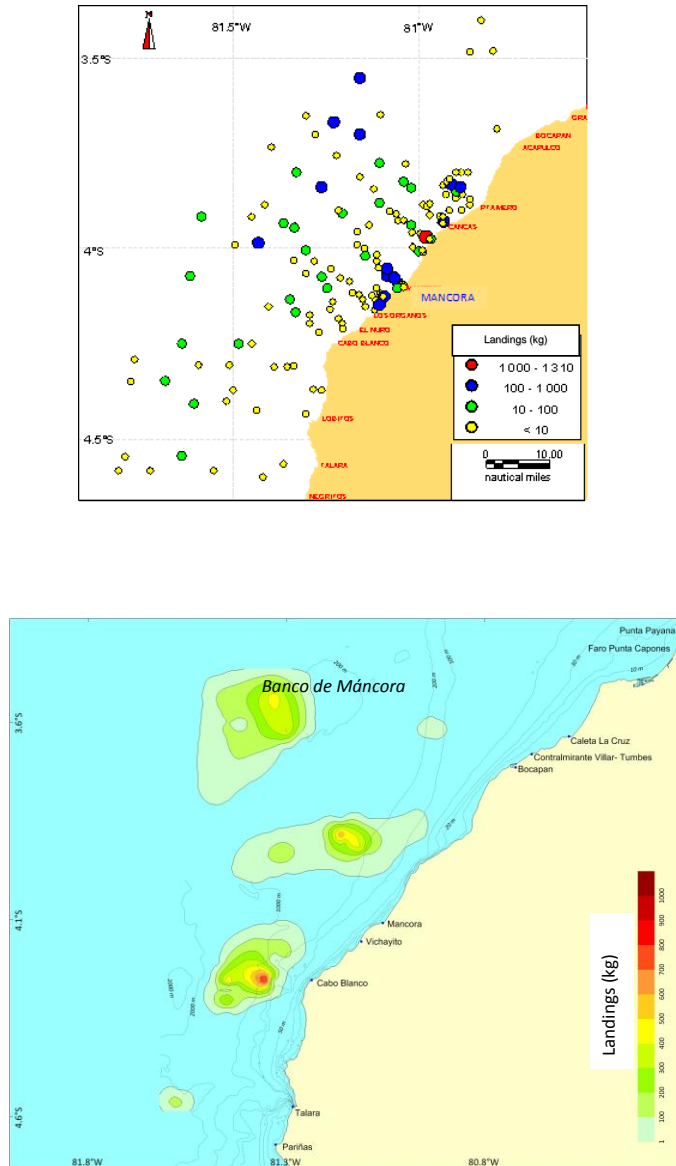


Figure 14. Location of fishing areas of the Mancora artisanal fleet: a) All fishing arts (2009 – 2010); b) Yellowfin tuna (gillnet; 2010).

knowledge about biology and ecology of these resources is still limited. In terms of fishing grounds, a large portion of the fleet fishes off Máncora, Los Organos and Punta Sal, within 30 miles off the coast. The fishing grounds of Yellowfin Tuna extend further, and the most important one is the so-called 'Banco de Máncora', a submarine elevation located about 30

miles north of the area. This elevation bears fossil reefs and a very high bathyal²⁶ benthic and nektonic biota, attracting large mammals and marine birds (Figure 14).

Proposed interventions

A map of the interventions in the Máncora pilot area is shown in Figure 15. As mentioned before, landings are characterized by a large variability in species composition and amount, according to the highly variable oceanic conditions. Among the top three resources in landing statistics for the past decade there is the Yellowfish Tuna. The landings of Yellowfish Tuna showed a tendency to increase in the past decade. It is worth to mention that the fluctuations of the landings of Yellowfish Tuna, and of other tropical oceanic species are related to ENSO. For instance, higher catches in 2003, 2007 and 2010, followed the moderate El Niño events in the past decade. Therefore it is expected that the availability of this resource would increase with climate change, but sub-optimal fishing practices lead to poor values of the fish products, while affecting other components of the ecosystem with by-catch. Also, given the uncertainty of the behavior of El Niño with climate change (e.g.

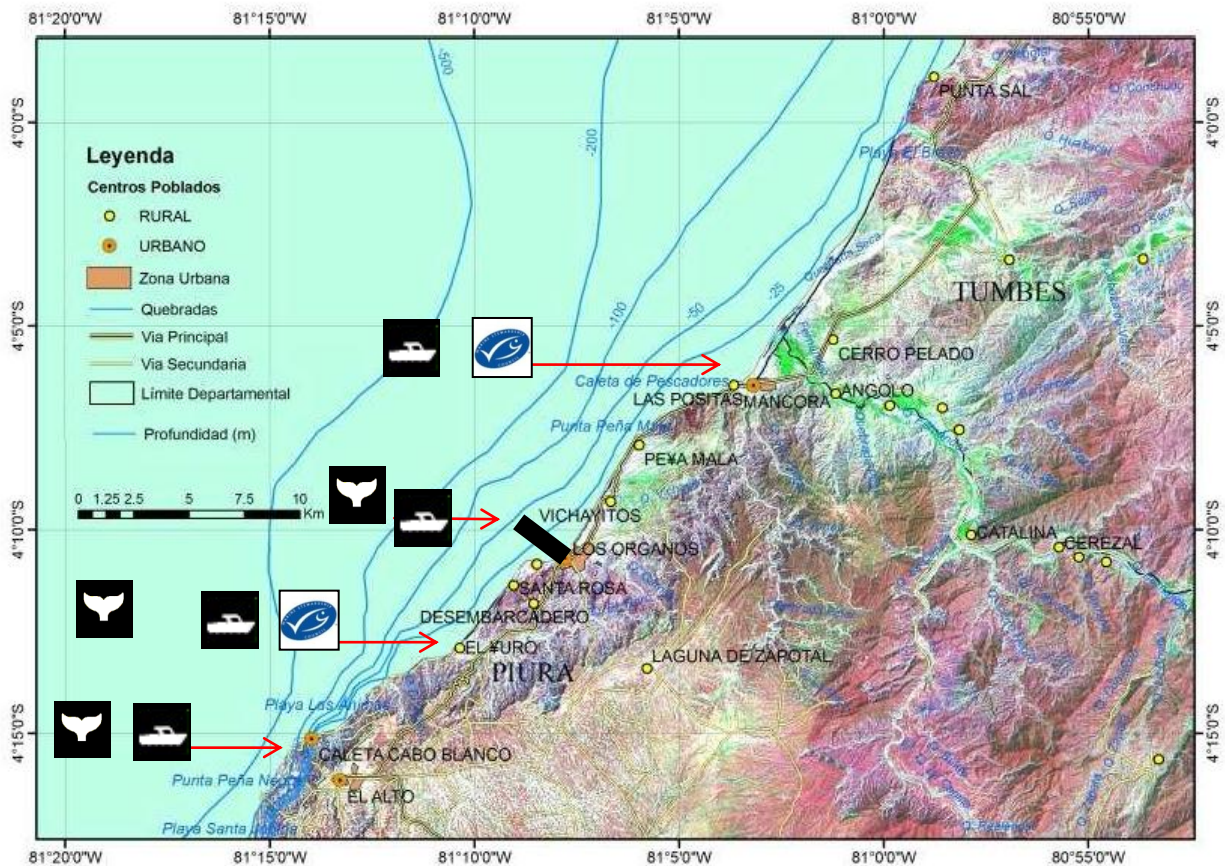


Figure 15. Map of potential interventions in the Máncora area. All together they might imply 100% replacement of purse seines by long-line (Máncora, Organos, Cabo Blanco and El Niño); 100% replacement of gill-net by long-line for offshore fishing I (Máncora); certification of the hake fishery with hook in El Niño and of the yellowfin tuna in Máncora, including development of business plans; at least one small ecotourism enterprise (landscape watching, whales watching, etc.) in Organos and the other in Cabo Blanco fishing coves.

²⁶ Relating to the region of the ocean bottom between the sublittoral and abyssal zones, from depths of approximately 200 to 2,000 m (656 to 6,560 ft) (<http://www.thefreedictionary.com/bathyal>)

increase in extreme events or just change in average conditions), it is necessary to apply a precautionary approach to safeguard the resilience of the resource and of the fishermen, Therefore, promoting the replacement of current fishing gears by long-line represent a win-win condition, both for the the ecosystem as for the artisanal fishing community. Likewise, there is a traditional fishing on hake at El Ñuro, using hook instead of nets. This community is already close to attain MSC standards for achieving certification and thus, open alternatives for increasing the value of the products. The project will assist towards this goal. Hake is known to be sensitive to changes in subsurface dissolved oxygen, a parameter that varies at interannual and decadal scales (Bertrand et al., 2011) and possibly with the ocean warming and increase of stratification. Given that hake is an important human consumption resource in the North, the success of this process might lead to replicate it to other coves, reducing the vulnerability of this species to oceanographic changes.

2) Huacho area, Lima region, Peruvian coastal upwelling ecosystem

General environmental description

The Huacho area is characterized by a complex topography with bays, capes and islands, as well as by the presence of wetlands. The cape Punta Salinas and the islands Don Martín, Huampanú and Mazorcas belong to a national marine protected system of Islands, Islets and Capes. The total protected area is 3312 ha for Don Martín Island, and 14207 ha for Cape Punta Salinas, Huampanú and Mazorcas (Figure 5). As other areas subjected to coastal upwelling, the waters are cold and very productive, being the natural habitat of the Peruvian anchovy *Engraulis ringens*. The topography favours the existence of natural banks of benthic invertebrates, among which there are several subtidal mollusk species of high commercial value and demand (see below).

Administratively, this pilot area belongs to the Huaura province (197,384 inhabitants), from which the main district, harbor and population center is Huacho (53,998 inhab). The two other districts with coastal populations and fishing coves are Carquín (6,091 inhabitants) and Végueta (18,265 inhabitants). The number of people working in the artisanal fishery are 907, 250 and 160, respectively, so that the families that depend directly from this economic activity are about 1300.

Huacho city (11°05'21" S 77°37'36"W) is the capital of the Huaura province, Lima Department. Huacho harbor is located in the Huacho Bay, limited by La Viuda point to the south and Carquín point to the north (Figure 16). South of Huacho Bay is Hornillos beach and El Colorado. North of Huacho Bay is Carquín Bay, where the Huaura river discharges its waters.

Economic activities and social conditions

The Huaura province has 197,384 inhabitants with a surface of 4893 km², with a population density around 40 inhab/km². The main population center is Huacho (53,998 inhab). Carquín has 6,091 inhabitants, with a surface of 2 km² and a population density of 2,986 inhab/km².

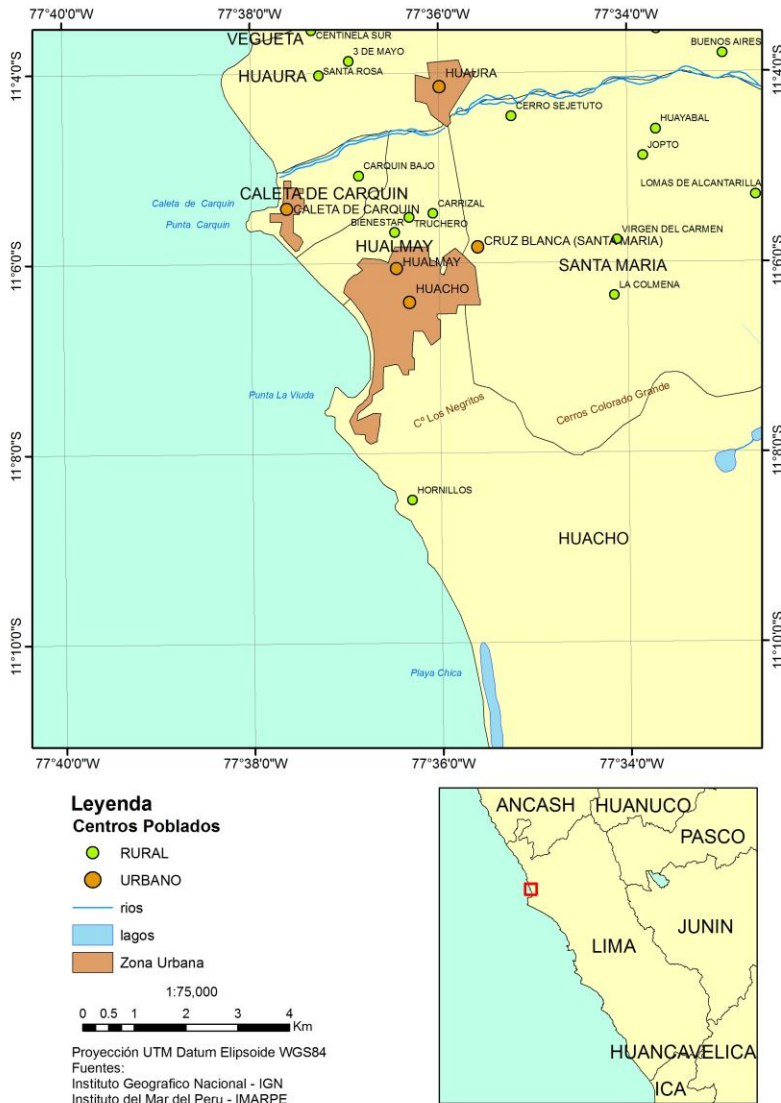


Figure 16. Geographic location of Huacho harbor.

In Huacho, the main economic activity is small scale commerce (9.2 % of population), teaching (7.9 %) – mainly related to the Huacho University – restaurants (6.1 %), building (4.6 %), transport (4.6 %) and fishery (3.2 %). In Carquín, economic activities comprise small scale commerce (17.5 %) and fishery (15.3 %), with two fishmeal plants, and artisanal harvest for direct human consumption. Also, in Carquín other activities such as agriculture, cattle, poultry, bovine and pork industries are developed.

Coastal marine zone management issues

The Huacho area contains a high diversity of species and natural banks of benthic invertebrates, due to the complex topography with large bays, points and islands, as well as the presence of several rivers. Points and islands belong to the recently

created system of Marine Protected Areas. However, in this region there exists a chronic danger of pollution due to industrial activity, domestic sewage and runoff of pesticides from agriculture (Villegas 2011).

Climate change will affect vulnerable areas such as the coastal zone of Huacho where the temperature changes could shift the spatial distribution of the species, and consequently the fishing grounds and biodiversity. On the other hand, poor populations will be less prepared to adapt to climate change due to the lack of technology and infrastructure.

Fishery issues - Landings

The Huacho harbor is considered an important center of industrial and artisanal fishery activity which generates positive impacts in the local and regional economy. The products of the artisanal fishery are directed towards the fresh consumption for the local market and the capital (Lima) (Barreto 2005).

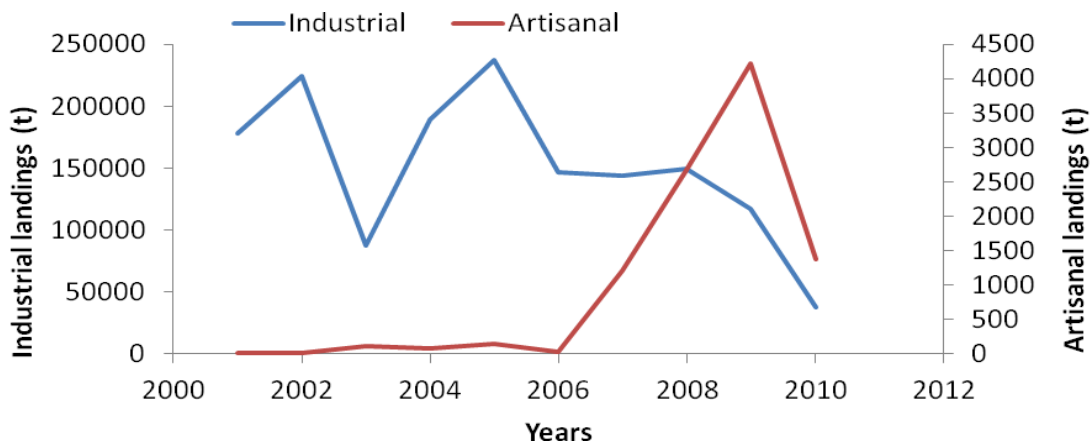


Figure 17. Total industrial and artisanal landings (t) in Huacho harbor, between 2001 – 2010.

The industrial fishery in Huacho during the period 2001-2010, landed 1,512,652t which represented 2.3 % of the national landings (65,461,835t); the landings were dominated by anchovy *Engraulis ringens* (97%) (IMARPE data). On the other hand, the artisanal fishery landed 9,797t of anchovy, during the same period (Figure 17). These numbers show the different relevance of industrial versus artisanal fisheries of Huacho in relation to Máncora.

Artisanal fishing targets in Huacho comprise oceanic fishes (Pacific bonito, dolphinfish, sharks), pelagic fishes (anchovy, jack mackerel, Pacific menhaden and mackerel), coastal fishes (delicious drum, striped mullet, silverside) and several invertebrates (razor clam, black snail, squid and black sea cucumber) (Figure 18a). Also, several fishing gears are used: purse seine, gillnet, autonomous diving, lung diving, long line, beach seine, among others (Figure 18b).

Between 2001 and 2010, the catch by the artisanal fleet grew reaching a peak of 4,218t/year, composed mainly by anchovy, but also by delicious drum, silverside and razor clam (Figure 19). However, the harvest under legal size limits could endanger the coastal resources (Gonzalez *et al.*, 2010).

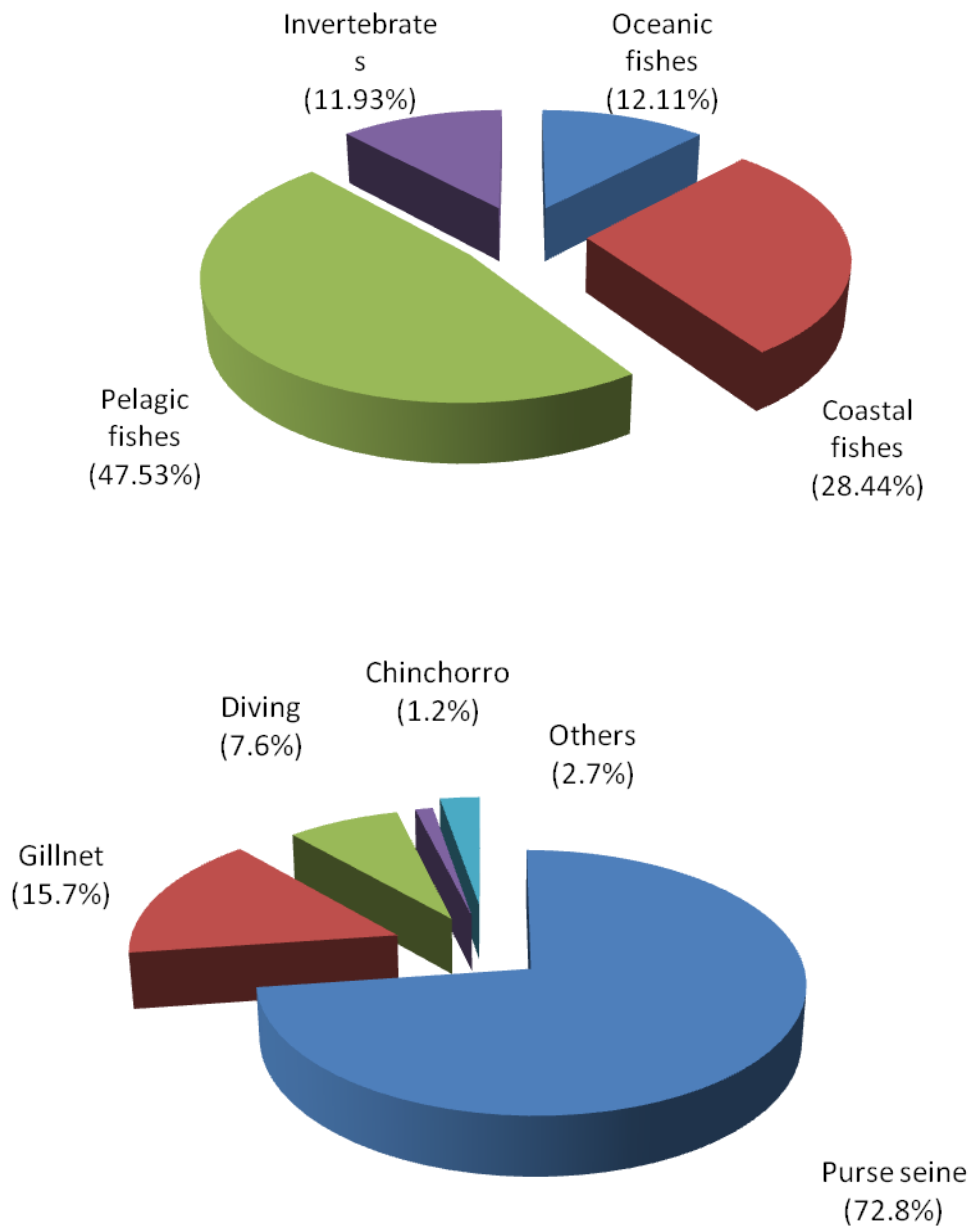


Figure 18. Summary of artisanal landing statistics from 2001 to 2010 in Huacho: a) Composition of the landings by fishery resources; b) Composition of the landings by fishing gears.

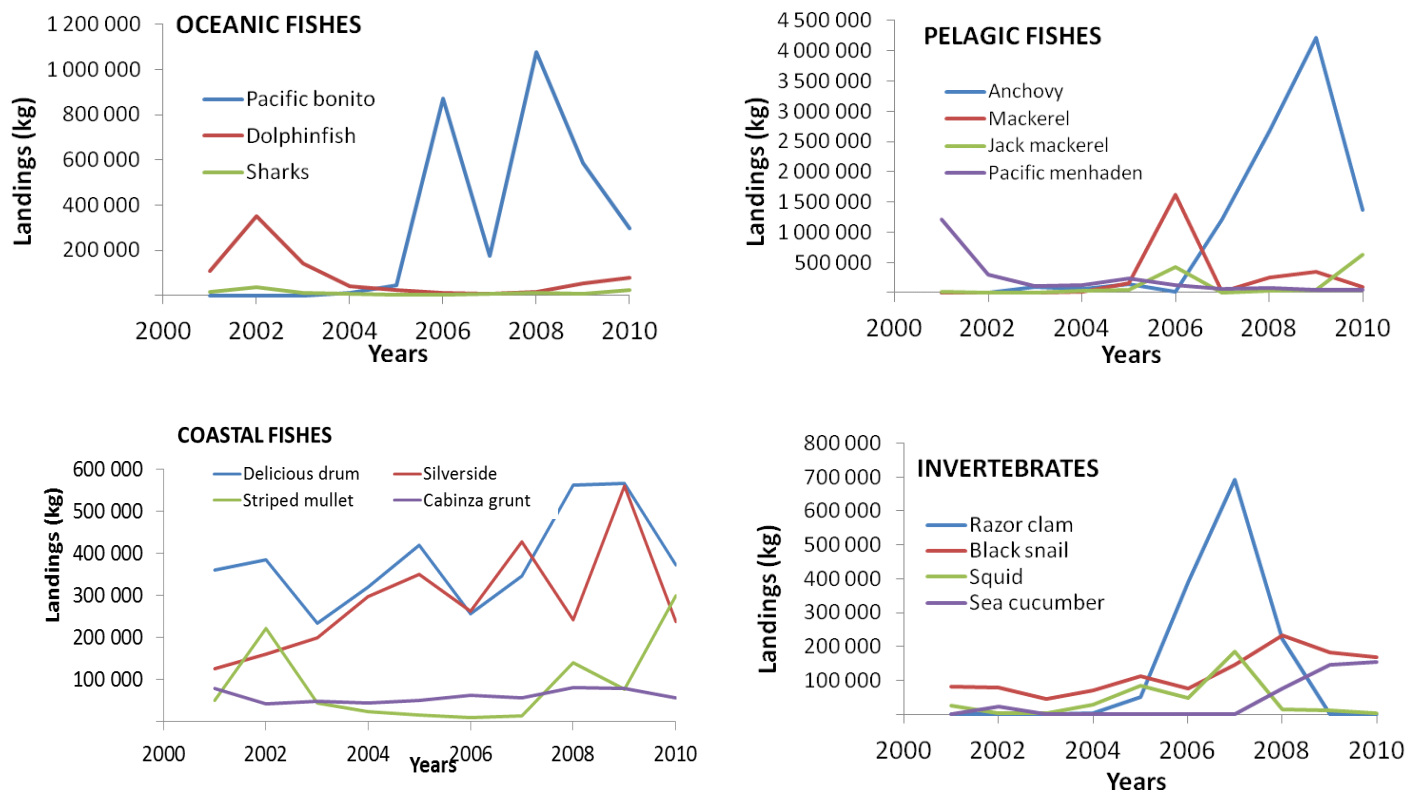


Figure 19. Time-series of the landings (kg) by resource categories in Huacho and their principal species: a) Oceanic fishes (Pacific bonito, dolphinfish, sharks); b) Pelagic fishes (anchovy, jack mackerel, Pacific menhaden and mackerel); c) Coastal fishes (Delicious drum, striped mullet, silverside and); d) Invertebrates (razor clam, black snail, squid and black sea cucumber).

Between 2001-2010, landings of 33,873t of hydrobiological resources comprised 75 species of fishes and 4 species of invertebrates. Species with largest landings were: *Engraulis ringens* (anchovy) with 9,796t (28,9 %), *Sciaena deliciosa* (delicious drum) with 3,826t (11,3 %), *Odontesthes regia regia* (silverside) with 2,868t (8,5 %), *Ensis macha* (razor clam) with 1,191t (4,0 %), *Ethmidium maculatum* (Pacific menhaden) with 2,368t (7,0%), *Stramonita chocolata* (black snail) with 3,826t (3,5 %), *Mugil cephalus* (striped mullet) with 1,355t (4,0 %), *Isacia conceptionis* (cabinza grunt) with 603t (1,8 %) and *Patallus mollis* (black sea cucumber) with 363t (1,1 %) (IMARPE).

The artisanal fleet uses mainly purse seines oriented to catch anchovy, delicious drum, Pacific menhaden, cabinza grunt, striped mullet and Patagonian squid. The seashell fleet uses semiautonomous diving oriented to razor clam, black snail, black sea cucumber and crabs. Another fleet uses beach seine to catch delicious drum, Patagonian squid, striped mullet, Pacific menhaden, snakehead kingcroaker, Pacific guitarfish and flatfish. Finally, a small fleet uses hooks to catch delicious drum, Peruvian morwong, Peruvian grunt, cabinza grunt and Patagonian squid. The use of purse seines with a mesh size of only 38mm, which is adequate for anchovy, has an impact on the higher prized species because it extracts mostly juveniles and creates conflicts with the gillnet fishermen which target the same species.

Banks and fishing grounds

The area between Carquin Point and the Choza (Playa Grande) has 37 km of coastline, with large sandy beaches, rocky points and small islands which are spawning areas of silverside (*Odontesthes regia regia*), while small bays are spawning areas of Patagonian squid and habitat for mole crab (*Emerita analoga*) (Figure 20).

The main commercial invertebrate species are: *Cancer porteri* (lemon crab), *Cancer setosus* (hairy crab), *Platyxanthus orbigny* (violet crab), *Aulacomya ater* (mussel), *Concholepas concholepas* (Chilean abalone), *Ensis macha* (razor clam), *Loligo gahi* (squid), *Sinum cymba* (Peruvian abalone), *Stramonita chocolata* (black snail), *Pattalus mollis* (black sea cucumber) and *Emerita analoga* (mole crab).

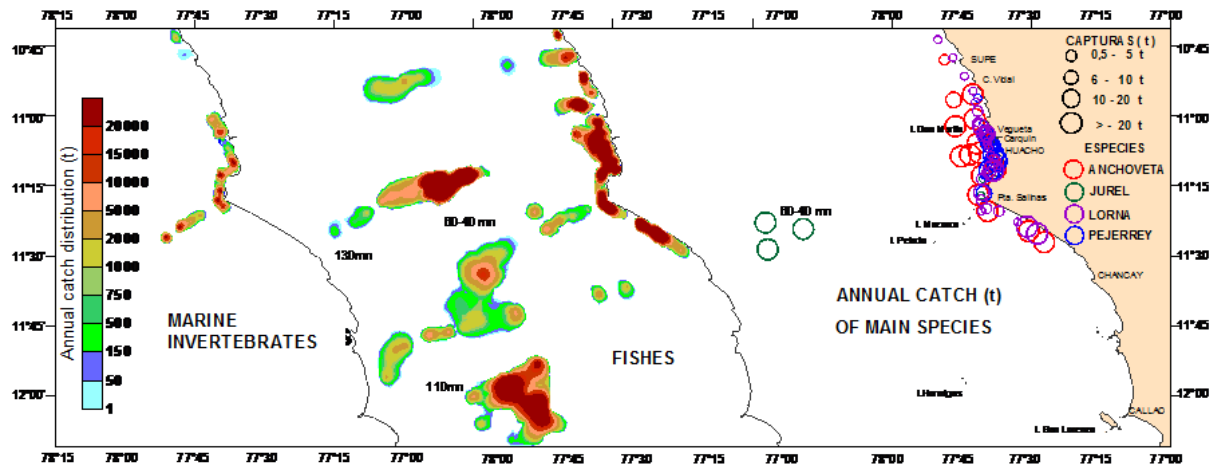


Figure 20. Location of fishing areas of the Huacho artisanal fleet: a) Invertebrates; b) Fishes; c) Annual catch of main species

Climate change impact on Peruvian anchovy population and artisanal fishing

The recent coastal cooling trend of Central and Southern Peru has not been translated in a positive trend of anchovy's biomass, which has exhibited interdecadal fluctuations following changes in upwelling and oxygenation (Bertrand et al., 2011). Since year 2000, the biomass is rather stable at about 10 to 12 million of tons (Fréon et al. 2008). Nevertheless acoustic biomass estimations suggest a northward shift in the gravity center of the population, from about 12 – 14 °S in the 1970's to 6 – 8°S in the last decade (M. Gutiérrez et al., accepted). The large fishing capacity by the industrial fleet (Fréon et al., 2008) might have limited the biomass growth, but other ecological factors linked to the environmental change could also have limited the carrying capacity. For example, the cold-water squat lobster *Pleuroncodes monodon* has increased its distribution northward, and its ecological niche partially overlaps with anchovy's. Also, increased coastal wind intensity may induce stronger turbulence and larger mortality of eggs and larvae of the anchovies. The future evolution of the carrying capacity for anchovy is uncertain, because it also depends on predator-prey relationship changes and water column oxygenation, both of which are related with the changes in water mass distribution and circulation processes that are still not well understood (Bertrand et al., 2011; Echevin et al., 2011; Gutiérrez et al., 2011).

Historically the Huacho harbor has been an important landing point for the industrial fishing of anchovy and several factories for fish meal and oil production are established. Since 2009, the artisanal fleet is fishing the anchovy, encouraged by the government policies to increase the direct human consumption, and now anchovy landings represent over 90% of

the total artisanal fishery landings in the area. However, the use of purse seines with a mesh size of only 38mm, which is adequate for anchovy, has an impact on the higher prized species because it extracts mostly juveniles and creates conflicts with the gillnet fishermen which target the same species. Furthermore, this fishing gear is not appropriate for the pretended use of direct human consumption, because the product arrives in damaged condition due to the character of the fishing practice, so that it is offered for the fish meal factories. The final effect is adding fishing pressure and increasing the vulnerability of this resource and of other coastal species. Therefore an adaptation strategy is needed to effectively reduce the fishing pressure on the fish species, while improving the incomes of the fishing communities, which all together would improve the socio-ecological resiliency to climate change impacts.

Exploitation of natural banks of benthic invertebrates

An active diving extraction of benthic resources occurs along the area. However, pollution due to industrial activity, domestic sewage and runoff of pesticides from agriculture (Villegas 2011), compromises the ecological health of the coastal environments located near towns, fishing coves and effluents. Some of the major banks are located onshore Don Martin Island, and in the cape Punta Salinas, offering a chance for their sustainable management. Unfortunately the 'Master Plan' for the marine protected areas here has not yet been formulated, and according to the normativity, it is the legal tool that would permit the marine spatial use planning for the reserve, involving activities as ecotourism, aquaculture and even recovery of natural banks (SERNANP, 2009). Two of the main benthic resources with high commercial value (for export and for national consumption) are the Peruvian scallop (*Argopecten purpuratus*) and the razor clam (*Ensis macha*).

Argopecten purpuratus is an edible marine filter-feeding bivalve, which inhabits sheltered sandy areas between 5 m and 40 m depth, from Panama through the coasts of Peru to Coquimbo in northern Chile. Gonadic maturity is accelerated during El Niño events off southern Peru and Chile due to high temperatures (Wolff, 1987), but sublethal temperature off Peru has been estimated in 29°C (Urban et al., 1994); consequently strong El Niños may have deadly effects on the banks located in the northernmost Peruvian coast. Scallops have a lifespan of up to five years, reaching almost commercial size (65 mm) in 180 days (Mendo et al. 2011). The species has a wide distribution along the Peruvian coast, being present in Don Martin Island. In the last decade, coinciding with the cooling trend and the absence of strong El Niños, the main productive area has changed from Independence Bay in the south (14°30'S) to Sechura (6°) in the north, though in the latter most of the production derives from extensive aquaculture (in suspended cages) which is connected with the management of the natural banks.

On the other hand, *Ensis macha* is a deposit feeding clam, which prefers silty sand and fine sand subtidal environments (5 to 20 m) for larval recruitment. Cannibalism for larvae is one of the characteristics of the species, limiting the recruitment area around the adult fields. Its main region of distribution is the Chilean coast, but the species has also expanded its latitudinal range northwards to even 06°S in the Peruvian coast in the last one to two decades (Espinoza et al., 2010). Off Peru its growth rate is more rapid than off Chile and it can attain the commercial size (125 mm) in about 2 years. The colonization of the Peruvian subtidal habitats triggered an uncontrolled extraction with hydraulic dredging, which damaged the population and the sedimentary properties, leading to the collapse of the banks in Independencia Bay in the mid 2000's (Espinoza et al., 2010). In the Huacho area, the main natural bank is in cape Punta Salinas, whereby hydraulic dredging has also been reported. Even that this practice has been forbidden by law, it is still a threat over the population and its habitat due to the lack of effective control and attractive fishing gears for economic profit. In Punta Salinas, a ban established in 2008 has allowed the recovery of the

adult population but the restoration of the silty sand bottoms are slow, putting in danger the renewal of the bank (IMARPE, 2011).

Integrity of the adaptation measures

The above mentioned coastal resource cases are examples of the threats and opportunities that climate change represents for a large portion of the Peruvian's coastal upwelling ecosystem and its stakeholders, particularly the artisanal fishery. The three resources are sensitive to climate-driven oceanographic changes and their distribution have responded to the recent environmental changes, but their future behavior is uncertain due to the non-linear character of the climate change impacts in the upwelling ecosystem (Echevin et al., 2011). Therefore adaptation measures need to be applied to maximize the opened opportunities and to minimize the vulnerabilities of the resources driven by the current fishing practices, limited information of the coastal ocean dynamics/ future regional climate change scenarios, and management limitations.

The proposed interventions will be mainly oriented to improve the resilience capacity of these three resources and of the local fishing communities; by means of: i) sustainable, fishing practices with profitable products (e.g. anchovy); ii) promotion of extensive aquaculture as an economic alternative (e.g. Peruvian scallop); and iii) stocking and re-stocking of natural banks of benthic invertebrates (e.g. razor clam).

For a sustainable and profitable anchovy fisheries, it will be promoted the use of an ecological friendly fishing gear (lift-net) in replacement of purse-seines, so that the pressure on anchovy's population and on other coastal species' will be diminished. At the same time, its handling, combined with a better preservation of the product on board, will allow an adequate quality for direct human consumption. A business plan will also be implemented for ensuring a sustained demand from fish markets. The interventions design comprises three steps: First, fishing tests and training activities will be carried out with one purse seine boat, selected or rented from the local purse seine fleet, and in agreement with the community. The goal is to demonstrate the comparative advantage in terms of the revenues from adopting this fishing gear. Second, the project will fund the fishing gear replacement for the whole purse seine fleet (20 fishing units) of the Huacho harbor, whereby a cold chain infrastructure already exists. Third, a fishery certification process will be started, following the Marine Stewardship Council overarching principles, in which the fishery must prove that it meets: **i) fish stock sustainability; ii) minimal environmental impact; and iii) effective management.** Access to markets will accompany the whole process in order to give sustainability to the adaptation measure. Fishery certification will increase the product's value and demand, which in turn will also add sustainability to the process. Success of the intervention will imply significant potential benefits for the artisanal fishing of anchovy along the coast, and also for the national goal to promote the direct human consumption over the fish meal and fish oil uses. The better economic revenues will permit to reduce the overall fishing pressure on the resource, reducing its vulnerability to climate change manifestations.

For extensive aquaculture as an economic alternative, the management of a concession area to culture *Argopecten purpuratus* will be implemented by means of suspended long-lines. The management will involve the participation, by agreement, of local shellfish fishermen, and technical assistance will be provided for establishing a small enterprise formed by the local fishermen which will ensure management sustainability beyond the project. The intervention will involve: i) technical assistance for the formulation of the project dossier and the formal requests to obtain the approval of the concession project; ii) investment on the infrastructure (long-lines), acquisition of the larvae and harvest; and iii) management of the concession area during the project. Operational costs, like the security surveillance of the area, maintenance of the long-lines and monitoring of the cultures will be

shared with the local shellfish fishermen association. According to similar experiences that have taken place in other Peruvian sites, net utilities are expected from the second year of the project. The intervention will comprise an area of 10 ha south of Huacho in front of Colorado and Hornillos beaches (Figure 21). Part of the scallops' yield will be used to stock

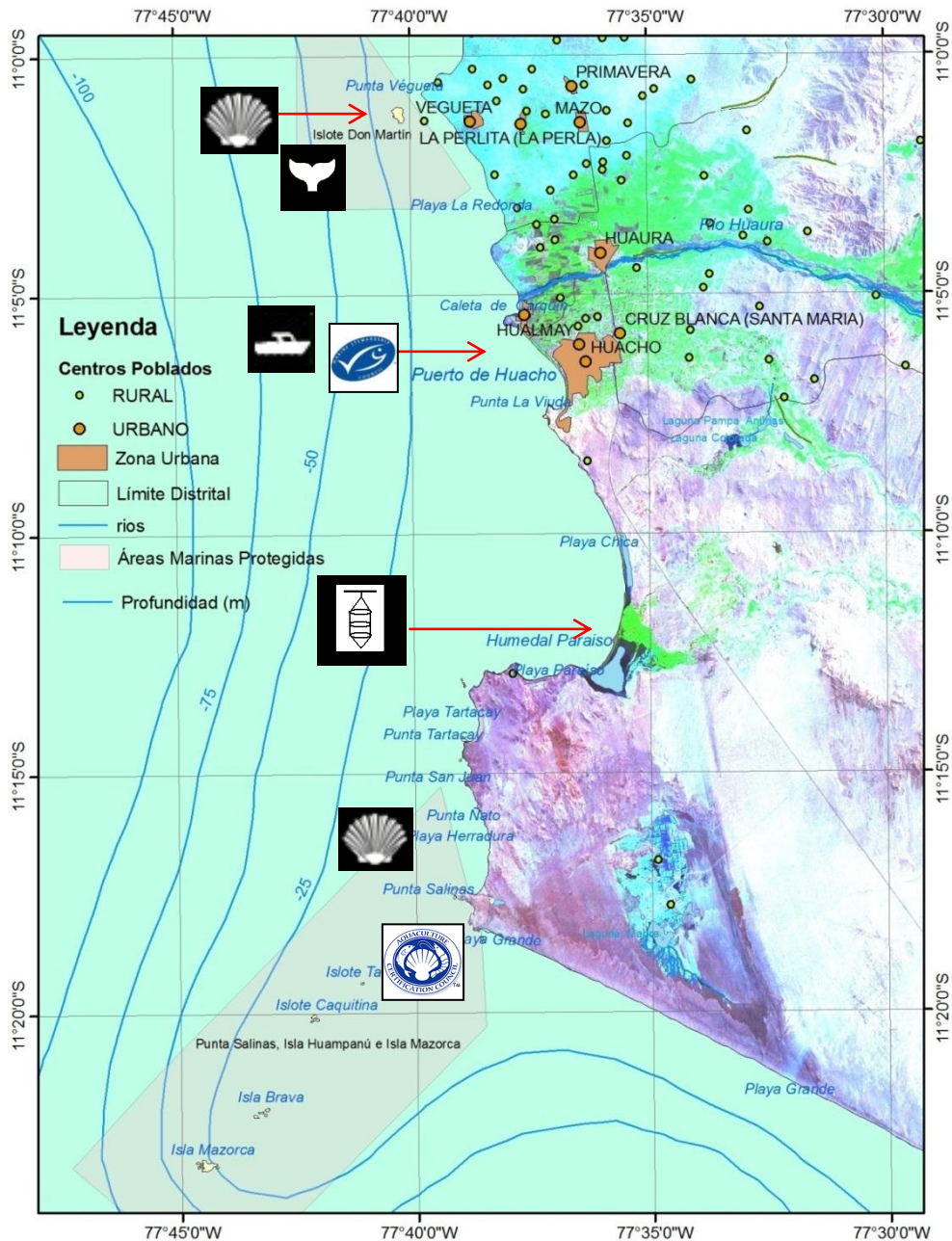


Figure 21. Map of potential interventions in the Huacho pilot area. The interventions might imply 100% of replacement of purse-seines by lift-net for artisanal fishing of the anchovy in vessels under less than 20 tons of store capacity (Huacho harbor); certification of the anchovy artisanal fishery here; certification of the razor clam extraction, following sustainable practices; a concession area for extensive and profitable aquaculture of the Peruvian scallop, linked to the re-stocking of natural banks in the marine protected areas, and natural production and supply of larvae for more concession areas outside the MPAs.

a natural bank of this resource, onshore Don Martin Island and/or onshore Punta Salinas, according to the zonification established by the Master Plan of the Reserve of Islands, Islets and Capes (see below). In addition, part of the utilities will be re-invested for monitoring and aquaculture research in the area. In this way, at least one source of natural larvae production will be established in the marine protected system, which would supply larvae for other aquaculture concessions along the Huacho coast, providing a sustainable alternative economic activity for the fishing community.

For re-stocking and/or management of natural banks, our main intervention will be focused on the *Ensis macha* razor clam fishery. As exposed above, the lack of effective management has put in danger the local banks of this resource, which otherwise has expanded its latitudinal range in accordance with coastal cooling. The intervention consists in two main actions. First, a technical assistance will be funded to identify an alternative extraction method with minimal impact on the substrate but attractive catch per unit of effort. Next, this extraction method will be promoted among the community by demonstrative training.

In parallel, based on the Master Plan of the protected area, the natural bank in the cape Punta Salinas will be spatially co-managed with the shellfish fishers under the control of the national reserve. The management strategy will combine 'no take' areas for the preservation of a spawning stock with areas under controlled extraction. The latter will reduce clam cannibalism and allow substrate availability for the settling larvae that will permit the renewal of the bank and a sustainable yield. The implementation of these practices fulfills the MSC principles for the fishery certification, so that a process towards this goal will be carried out. The certification will bring or ease the access to international markets with fair values of the product. In this way, the razor clam's extractors will become allies and beneficiaries of a sustainable fishery, ending with a win-win resilience condition, both for the resource and for the fishing community.

The interventions will be complemented by specific long-term adaptation measures to improve governance and the response capacity of the government to address climate change effects on the marine coastal ecosystem and resources availability, as mentioned in section A of the proposal.

ANNEX II - REFERENCES

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ANNEX III. GLOSSARY

AF, Adaptation Fund

Bathyal, relating to the region of the ocean bottom between the sublittoral and abyssal zones, from depths of approximately 200 to 2,000 m (656 to 6,560 ft).

Benthic, describing a fish that lives close to the floor of the sea or a lake.

DGEX, Dirección General de Extracción, General Direction of Harvest.

DGPA, Dirección General de Pesca Artesanal, General Direction of Artisanal Fishery.

DGA, Dirección General de Acuicultura, General Direction of Aquaculture.

DGAAP, Dirección General de Asuntos Ambientales de Pesquería , General Direction of Environmental Issues in Fisheries.

EAF, Ecosystem Approach to Fisheries, an extension of conventional fisheries management recognizing more explicitly the interdependence between human well-being and ecosystem health and the need to maintain ecosystems productivity for present and future generations, e.g. conserving critical habitats, reducing pollution and degradation, minimizing waste, protecting endangered species (Ward et al. 2002).

EBA, Ecosystem Based Adaptation, integrates the use of biodiversity and ecosystem services into an overall strategy to help people adapt to the adverse impacts of climate change (CBD, 2009).

EBM, Ecosystem Based Management Ecosystem-Based Management, is a globally recognized approach for better understanding and managing the interactions between uses and the natural system, and integrating multi-sectoral interests into decision making for the whole marine ecosystem.

EF, Equatorial Front; latitudinal range off Northern Peru where surface tropical waters mix with colder waters with higher salinities from coastal upwelling.

ENSO, El Nino Southern Oscillation.

ERA, Ecological Risk Assessment, is an effective and transparent methodological structure to assess potential risks to all essential components of a studied fishery, namely the ecological as well as the human well-being.

GEF, Global Environment Fund.

GoP, Government of Peru

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT²⁰ *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

<p>Viviana Grissel Zaldivar Chauca (Advisor); Asesora, Gabinete de asesores de la Alta Dirección, Ministry of Environment (MINAM)</p>	<p>Date: April 24th, 2012</p>
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B. IMPLEMENTING ENTITY CERTIFICATION *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

<p>I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans (e.g. <i>Second National Communication to the UNFCCC, National Strategy for climate change and its Action Plan for mitigation and adaptation, National Environmental Policy</i>) and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.</p>	
<p><i>SONIA M. RIVERA</i> <i>Sonia Ma. Rivera</i> Name & Signature Implementing Entity Coordinator</p>	
<p>Date: (Month, Day, Year)</p>	<p>Tel. and email: <i>202-623-2018 SONIA.R @ IADB.ORG</i></p>
<p>Project Contact Person: <i>ALFRED H. GRUNWALDT</i></p>	
<p>Tel. And Email: <i>202-623-1895 ALFREDG @ IADB.ORG</i></p>	

⁶ Each Party shall designate and communicate to the Secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.



PERÚ

Ministerio
del Ambiente

"Decenio de las Personas con Discapacidad en el Perú"
"Año de la Integración Nacional y el reconocimiento de Nuestra Diversidad"

Lima, April 24, 2012

Letter N° 02-2012-MINAM/DM/VZCH

The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

Subject: Endorsement for "Adaptation to the Impacts of Climate Change on Peru's Coastal Marine Ecosystem and Fisheries".

In my capacity as designated authority for the Adaptation Fund in Peru, I confirm that the above national project proposal is in accordance with the government's national priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in Peru.

Accordingly, I am pleased to endorse the above project proposal with support from the Adaptation Fund. If approved, the project will be implemented by the Inter-American Development Bank and executed by the Ministry of Production.

Sincerely,

Viviana Zaldivar Chauca
Adviser Ministry of Environment
Designated Authority