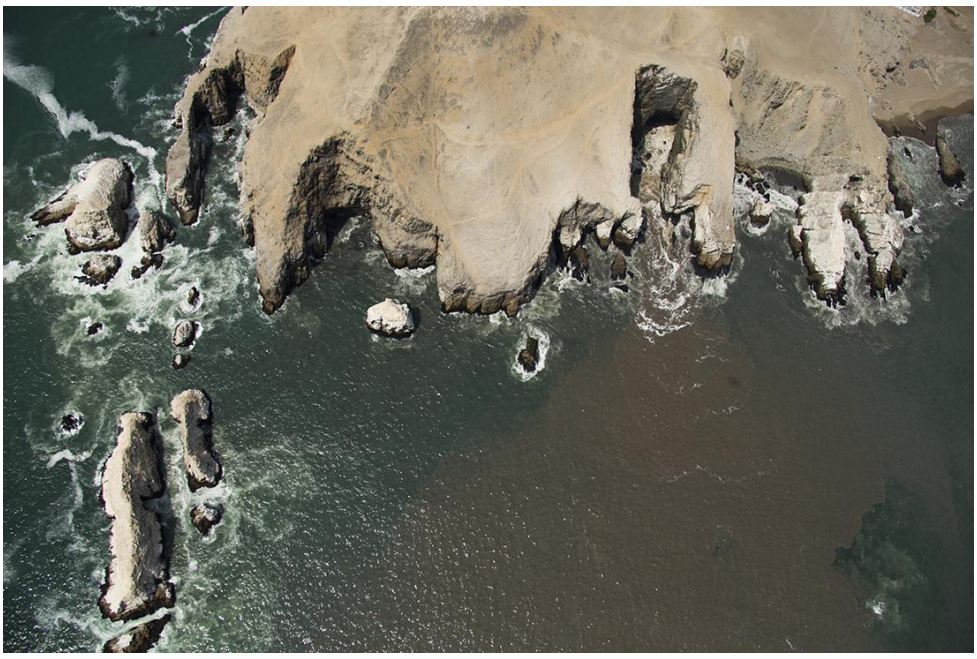
Towards Ecosystem-Based Management of the Humboldt Current Large Marine Ecosystem

Project GEF - UNDP – HCLME 2011-2016

EXECUTIVE SUMMARY

POLLUTION AND ECOSYSTEM HEALTH MODULE INDICATORS - HCLME



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EXECUTIVE SUMMARY

The Humboldt Current Large Marine Ecosystem is part of a group of four main areas of upwelling of the planet. The HCLME is considered a Class I, highly productive, >300gC/m^2/year. It extends along the coast of Chile and Peru, starting at around 40ºS with a northerly flow towards the equator, until the 5 degrees south latitude, in the north of Peru. Its border to the west is the 200-mile Exclusive Economic Zone of Chile and Peru and to the East is defined by the line of influence of the tides on earth. It is one of the largest LMEs marine ecosystems in the world. .

The HCLME is a partially wind driven, cold water, and relatively low saline flow along the eastern margin of the South Pacific Ocean. It encompasses a complex mosaic of currents, composed mainly of cold-water masses with biodiversity (BD) of global importance (Tomczak and Godfrey, 2003). Periodically, the upwelling that drives the system's productivity is disrupted by El Niño-Southern Oscillation (ENSO) events. When this occurs, fish abundance and distribution are significantly affected, often leading to stock crashes and cascading social and economic impacts (Arntz and Fahrbach 1996).

The goal of the Humboldt Current Large Marine Ecosystem project is to advance toward a sustainably used and resilient HCLME with a Ecosystem-Based Management (EBM), that can maintain biological integrity and diversity and ecosystem services for current and future generations despite changing climatic and social pressures.

The objective of this thematic report is to update the Pollution and Ecosystem Health Module (Module III) in the existing Transzonal Diagnostic Analysis (TDA) document (approved in 2003) as an input to a new TDA identifying the problems faced by the HCLME.

Currently there are the following policies at national level in regard to the Management Scope of Marine and Coastal Areas:

- National Environmental Policy
- National Environmental Action Plan
- Multisectoral Commission of Marine Environmental Management
- Action Plan of Marine Biodiversity Conservation.

The surface of Marine Protected Areas within Peru is 401 556, 29 ha from a total at a national level of 22 162 876, 39 ha. That is to say, 1.8 % of the total surface of protected areas on the national level is on the marine environment.

In addition, it is important to mention that of the 77 Natural Protected Areas of Peru that form part of the National System of Natural Areas protected by the State (SINANPE in Spanish), 8 are in coastal area and 3 of them include marine environments. These are:

- Paracas National Reserve with 335 000,00 ha.
- San Fernando National Reserve with 154 716,37 ha.
- System of Islands, Islets and Guano Points National Reserve (RNSIIPG) with 140 833,47 ha.

I. PROBLEMS RELATING TO POLLUTION AND ECOSYSTEM HEALTH INDICATORS

This chapter describes problems associated with: high levels of concentration of nutrients; biochemical oxygen demand (BOD); harmful algae blooms or potentially toxic phytoplankton; and sanitary requirements of processing areas and of landing sites for preventing pathologies and emerging diseases, such as cholera.

Likewise, it is mentioned the indices, standards, limits and/or environmental parameters that currently are being used in the evaluation of the environmental quality of the effluents and emissions, in order to maintain a good state of the marine environment. Also, it is appointed the Ocean Health Index (IHO), the index of the sanitary quality of the beaches, the Environmental Quality Standards (EQSs), the Maximum Permissible Limits (MPLs) and the different regulations in process.

1.1 NUTRIENTS, EUTROPHICATION AND HAB

1.1.1 Nutrients Inputs:

The raise of nitrates, nitrites and phosphates levels, generates an excessive development of primary production. Decomposition of all this material (primary production) results in drastic reduction of the dissolved oxygen in the water column, changing the watercolor and increasing the turbidity of the marine water column.

It is important to mention that at the Peruvian coast, upwelling events occur continuously at subsurface water. This is mainly by action of the trade winds (SE). These masses of seawater are rich in nutrients, which contributes to the high primary productivity that occurs in the Peruvian coast. The main upwelling sites are: San Juan of Marcona, Callao and Chimbote; where take place the development of a major phytoplankton biomass, giving rise to the start of the food chain in the marine environment.

IMARPE data for the period of 2005-2009 shows the minimum and maximum concentrations (µg-at/L) of nutrients in marine areas of the coast of Peru. As a result, at Callao Bay occurs:
- Strong interannual sign with less nitrates concentration (< 10 µmol/ L) and minimum values of nitrites in the water column were present during El Niño 1997 - 1998.
- Between 1999 and 2001, the nitrates mean was inferior to 10 µmol/L. The maximum superficial values of nitrites (until 9 µmol/L) concurred with the intense development of OMZ and the brief thermocline.
- After 2002, the water column presented nitrates > 20 µmol/ L and nitrite < 1 µmol/ L.
- Values increased again in the summer of 2006, 2007 and 2009.

1.1.2 Species of Potentially Toxic Phytoplankton

In the framework of the "Health Standard for Live Bivalve Molluscs" and the support that the IMARPE provides to the Health Authority SANIPES - ITP, it was updated the list of Potentially Toxic Species for the 2012. This list has been used by support entities for reports of phytoplankton. In this update have been considered the following taxonomic groups:

DIATOMS
Pseudo-Nitzschia
Pseudo-Nitzschia gpo *delicatissima*
Pseudo-Nitzschia gpo *seriata*

DINOFLAGELLATES

Alexandrium minutum
Alexandrium monilatum
Alexandrium ostenfeldii
Alexandrium peruvianum
Dinophysis acuminata
Dinophysis caudata
Dinophysis rotundata
Dinophysis tripos
Prorocentrum lima
Prorocentrum minimun

OTHERS

Cochlodinium polykrikoides
Gonyaulax spinifera
Karenia sp.
Karlodinium cf. *veneficum*
Protoceratium reticulatum
Lingulodinium polyedrum
Protoperidinium crassipes
Gymnodinium sp. = G. Impudicum
Heterosigma akashiwo

P. minimum appeared in 2005 in Pisco-Peru. It is a potentially toxic species, which in a stage of its growth cycle turns toxic (Kat, 1979). This species can produce two types of the hepatotoxic toxin and the toxin of the diarrheal molluscs (Shimizu 1987). Also the presence of P. minimum has been associated with the death of fish and molluscs (Steindinger 1993). In Peru, the times that have been identified have been associated to the presences of toxin DSP (diarrheal toxin of the molluscs).

1.2 PATHOLOGY AND EMERGING DISEASES

The Division of Sanitary Control of the Aquaculture Environment, of the Direction of the National Service of Fishing Health – SANIPES -ITP, developed on March 15th of 2011 the "Control Program of Bivalve Molluscs (PCMB)"; which was adopted on March 18th of the same year. The Program is administered by SANIPES, from its headquarters (Callao), with branches located in Tumbes, Paita, Sechura, Chimbote, Callao, Pisco and Tacna.

According to the Guide of Sanitary and Phytosanitary requirements for export food to the European Union of the MINCETUR and PROMPERU (2010), the animal health conditions and certification requirements for the importation of molluscs are regulated by the Decision 2003/804/EC. While the directive 2006/88/EC lays down the health requirements for animal and aquaculture products, and the prevention and control of certain diseases of aquatic animals. The test methods for the products to be export are established in the Manual of Methods of Shellfish and Water Testing of SANIPES. The 2012 Classified Production Areas for exportation (where monitoring stations exist and controls of sanitary indicators take place) were: Aguja Point, Nonura, Samanco Bay, Salinas, Guaynuna and Ilo.

ASSAYS TO BE EXECUTED:

In Product:
- Biotoxines (DSP, PSP, ASP)
- Microbiologics (*E. coli, Salmonella*)
- Biologics (VHA, Norovirus I and Norovirus II)
- Chemicals (cadmium, lead and mercury depending on the area)

In Sea Water:
- Biologics (potentially toxic phytoplankton)
- Microbiologic (fecal coliforms)
- Chemicals (oils and fats, hydrocarbons, phenol, detergents, chromium, arsenic, selenium, manganese and total zinc)

At the present, according to FONDEPES of the 44 boat landing sites in Peru only 3 have submarine emitter (San Andrés, Ñuro and Talara); and only 2 accomplish the Health

Standard 040 - 2001 and 007 -2004 (San Andres and the Chaco).

1.3 HEALTH INDEXES ON THE ECOSYSTEM

1.3.1 Ocean Health Index (OHI)

This index is a new and full measure to qualify the health of the oceans with scores from 0 to 100. This methodology defines a healthy ocean as one that in a sustainable way offers a wide range of benefits to people, both in the present time and in the future. Globally, the overall index score was 60 out of 100 (range 36–86), with developed countries generally performing better than developing countries, but with notable exceptions. Only 5% of countries scored higher than 70, whereas 32% scored lower than 50. The index provides a powerful tool to raise public awareness, direct resource management, improve policy and prioritize scientific research.

Peru obtained a score of 44 on 100 points, globally ranked 152. The 10 public goals, that organized the Index, measure benefits that a healthy ocean provides to people. All scores range from 0 to 100. For Peru we have the following scores:

- Food Provision = 0 points
- Artisanal Fishing Opportunities = 89 points
- Natural Products = 56 points
- Carbon Storage = 37 points
- Coastal Protection = 37 points
- Coastal Livehoods & Economies = 46 points
- Tourism & Recreation = 00 points
- Sense of Place = 43 points
- Clean Water = 66 points
- Biodiversity = 70 points

Using the data available of the best scientific sources, the index calculates an annual overall score that reflects the current status, recent trends and the negative or positive influences on the health of the ocean (www.oceanhealthindex.org).

1.3.2 Sanitary Health Index Of The Beaches (ICSP)

On 26th of August of 2010, by Ministerial Resolution Nº 659-2010/MINSA was approved the Health Directive Nº 038- MINSA/DIGESA - V.01, proposed by the General Directorate of Environmental Health of the Ministry of Health. This establishes the procedure for the assessment of the sanitary quality of the beaches of the Peruvian coast. Through this directive is prevented and controlled the different risk factors of pollution that can occur in the beaches, which could danger human health.

<u>Procedure for the Sanitary Quality Assessment of the Beaches of the Peruvian Coast:</u>

A) The ICSP uses 3 qualification criteria:

1. Microbiological Quality (0,50 points maximum)
2. Cleaning Quality (0,45 points maximum), which is based in 2 criterias: the Beach Cleanup (0,40 points) and the Presence of Containers for Solid Wastes (0,05 points).
3. Presence of Toilets Facilities (0,05 points maximum)

B) Results are added and according to the points of ICSP obtained the beach qualifies as: Healthy, Regularly healthy or Not Healthy.

1.3.3. Environmental Quality Standards - EQSs and Maximum Permissive Limits - MPLs

Environmental Quality Standards – EQSs:

- Supreme Decree N° 074-2001-PCM (Jun/22/01) "Regulation of the National Standards of Environmental Quality of the Air".
- Supreme Decree N° 002-2008 MINAM (Jul/31/08) "Approval of the National Standards of Environmental Quality of the Water".
- Supreme Decree N° 003-2008 MINAM (Ago/21/08) "Approval of the National Standards of Environmental Quality of the Air".
- Supreme Decree Nº 023-2009-MINAM "Approval of Regulations for the Implementation of the National Standards of Environmental Quality (EQS) of the Water".

* Currently In Progress: Update of the EQS for Superficial Waters

Maximum Permissive Limits – MPLs:

- MPL for Energy and Mine Sector.
- MPL for Production Sector.
- MPL for Transportation and Communications Sector.
- MPL for Housing, Construction and Sanitation Sector.

* Norms In Process:

- S.D. That modifies the S.D. N° 010-2008- PRODUCE. MPL for the fishmeal and fish oil industry and the complementary norms.
- MPL for BOD_5 of fishery effluents.
- MPL for fishery effluents industry of direct human consumption.
- MPL for effluents of aquaculture industry.
- MPL for liquid effluents for the steel industry.

1.4 MULTIPLE MARINE ECOLOGICAL DISTURBANCES

Strandings:

- Marine mammals: Until the present day, there is no answer of why 877 dolphins beached in the summer of 2012 between Punta Aguja and Chérrepe.
- Sea Lions: In 2009, 90% of 263 male mongrel sea lions confirmed poisoning by carbamates.
- Birds: February 2012, massive death. Perturbation of the natural fish distribution resulted in decrease of food for pelicans and boobies.

II. COMMON SHARED PROBLEMS RELATING TO POLLUTION AND ECOSYSTEM HEALTH INDICATORS

The diversification of anthropogenic activities on the Peruvian coast leads to environmental degradation, by what the environmental management and mitigation of pollution is increasingly important. There are a number of sources that in a direct or indirect way pollute the marine and coastal ecosystem. The entry pathways can be atmospheric, terrestrial and maritime. Within the economic activities on the coast that impact the HCLME we have: fishing, aquaculture, oil, mining metallic and non-metallic, metals, agriculture, energy, tourism and sport, commercial, industrial, maritime and land transportation, and coastal development.

This chapter brings up the common shared problems relating to pollution that impact the HCLME. Among them are: sewage from ships (bilge water and oily mixtures, ballast water), domestic sewage, industrial effluents, emissions, and solid waste (municipal solid wastes, industrial solid waste, construction and demolition waste, ship and fishing industry waste and marine litter). It is also brought the issue of heavy metals, persistent organic pollutants (POPs), hydrocarbons, physical alteration and destruction of habitat and marine noise pollution.

2.1 WASTE FLUIDS FROM SHIPS

2.1.1 Sewage and oily mixtures

Taking as a precedent the Convention of MARPOL 73/78, the directorial resolution Nº 0766-2003-DCG and the Nº 442-2005/DCG; it was approved on March 21st of 2013 the Directorial Resolution Nº 087-2013-MTC/16. This document contains the "Guidelines for the management of oily mixtures, sewage and garbage from vessels in the National port sector ". This seeks to ensure that the port terminals of Peru, counts with adequate facilities and/or reception services for all kinds of waste from the ships in order to avoid the pollution of the marine environment, river or lake.

To date, 18 port facilities at the national level of different port administrators and use have an Environmental Management System (EMS). Of which 10 are ISO 14001:2004, 7 are in the process of implementation and 1 counts with NOOR 008. It should be noted that 13 of them implemented the EMS on a voluntary basis and 5 by concession contract.

2.1.2. Ballast Water

The directorial resolution Nº 072-2006/DCG of March 1st of 2006, implement the provisions of IMO Resolution A. 868 (20) “Guidelines for Improving the Control work of the discharge of ballast water and sediments of ships”. The Globallast project refers to the progress of the establishment of standardized protocols for sampling, in line with the IMO guidelines mentioned above.

Between August of 2010 and February of 2011, DICAPI, IMARPE and the Port Captaincy of Callao, monitored the receiving marine water body and the ballast water of 10 ships that entered the Port of Callao. The results were:
- High values of phosphates from Matthew 3 (5.85 mg/L) and APL MANAGUA, which missed the EQS.
- The highest densities of dinoflagellates phytoplankton were recorded in the ballast water of the ship Matthew 3 Colonel from the Port of Chile, being *Glenodinium sp.* the more abundant (5.500 ncel/L). It should be noted that the Clipper ship Makishio from the Port of Ilo presented the highest densities of micro flagellates (3.60E+09 Ncel/L) being the *Heterosigma akashiwo* specie the most abundant. In this same vessel was noted the presence of copepods, nauplius, and bivalve larvae but at low densities. In general, the majority of the species founded are already recorded for our coasts (Ochoa et al. 1999) with the exception of the species of the genera *Navicula* and *Glenodinium.*
- In regard to the microbiological charge the higher counts of thermotolerant coliforms were obtained in the CSCL ship from Sao Paulo, 274 cfu/ 100ml. The highest values of the counts of *Escherichia coli* were observed in the ship Vega Leader (42 cfu/100 ml) from Guatemala.

The maximum value of heterotrophic was obtained in the ballast water of Makishio Clipper ship from the Port of Ilo (3.0 x 104 cfu/100 ml).

According to these results it was concluded a disturbance of the physical-chemical parameters and a not comply with the IMO guidelines of 2004 neither with the EQS according to national regulations. On the other hand it was notice the presence of organisms that could produce harmful algal Bloom (HAB). Consequently, there is the potential risk to affect to the health of the ecosystems, biodiversity and human health (Orozco R. et al, Globallast Project 2011).

2.2. DOMESTIC WASTEWATER AND EFFLUENTS

2.2.1 Domestic Wastewater

During 2007 the sewerage systems recollected approximately 747.3 million m^3 of wastewater. Of this volume, only 29,1 % was admitted to a sewage treatment system, and the rest was discharged directly to a receiving water body (sea, rivers or lakes) or infiltrated into the soil. That is to say, that surface water bodies (including marine environment) were contaminated by at least 530,0 million m^3 of wastewater. At Peru, until 2008, there were a total of 143 wastewater treatment plants (WWTP), but only a few are successful projects (SUNASS, 2008).

During the past few years, IMARPE has monitored selected marine and coastal areas with the objective of evaluating marine pollution indicators. The 2012 Environmental Statistics Yearbook of INEI, shows the ranges (minimum and maximum values) during the period 2006 – 2011 of thermotolerant coliforms in seawater of the Bays of Paita, Sechura, Santa Rosa, Coishco, Ferrol-Chimbote, Santa - Ancash, Tortugas, Huarmey, Supe-Paramonga, Huacho, Chancay, Lima-Miraflores , Callao, Cañete and Pisco.

It can be seen that in most of the bays (the years that have data), presented maximum concentration of thermotolerant coliforms above 1000MPN/100 ml, maximum accepted by the EQS of Water (overview of the categories of classification, I, I and IV). It is also appreciated at the Bay of Callao excessively high values of thermotolerant coliforms, having come to have a maximum of 2.4 x 1011 MPN/100 ml in 2009. On the other hand in the Bays of Santa Rosa, Coishco, Ferrol-Chimbote, Supe-Paramonga, Huacho and Chancay there are very high peak concentrations of thermotolerant coliforms.

The Wastewater Treatment Plant (WWTP) Taboada began its operations in early 2013 in Callao to treat 442 million m^3 of wastewater per year, representing 60% of the drains of Lima and Callao. This WWTO will treat the wastewater of the beaches of North Lima until the beach Marbella in Magdalena. Moreover, the WWTT The Chira, which will begin to be build in March of this year, will decontaminated the beaches from Magdalena to the district of Chorrillos.

2.2.2 Effluents Of The Fishing Activity

On April 30th of 2008, through the Supreme Decree N° 010-2008-PRODUCE was approved the Maximum Permissible Limits (MPL) for the industry of fishmeal and fish oil and complementary standards for industrial fishing establishments or new fish processing plants

and for those who were relocated. It is compulsory that no fishing industrial establishment or processing plant may operate if do not comply with the MPL for oils and fats (A&G), total suspended solids (TSSs), biochemical oxygen demand (BOD_5) and acidity or alkalinity (pH).

It is also forbidden the discharge of effluents in fragile areas such as: marine-coastal wetlands, estuaries, protected natural areas, nearby areas to guano islands or points, water bodies with restricted movement or low renewal capacity, among others.

To monitor the compliance of the MPL should be considered the Monitoring Protocol for Effluents and Marine Corps Receiver, which was approved by Ministerial Resolution N° 003-2002-PE. The update of the Environmental Management Plan provides a period of adequacy of 4 years to meet the MPL of column II. The deadline was the 1st of March of 2013, currently extended until December of 2013.

2.3 EMISSIONS OF FISHING ACTIVITY

By Supreme Decree 011-2009-MINAM was approved the Maximum Permissible Limits (MPL) for emissions from the industry of fishmeal and fish oil and from the industry of meal of hydrobiological waste. The values set as MPL for emissions of the point source, are 5 mg/m3 of Hydrogen Sulphide or sulphides and 150 (mg/m3) of particulate material (PM).

Through Ministerial Resolution 194-2010-PRODUCE, was approved the Protocol for the Monitoring of Atmospheric Emissions and Air Quality of the Fishmeal and Fish Oil Industry, as for the Industry of Meal of Hydrobiological Waste, with the aim to standardize the methods of sampling and analysis. Thus, ensuring the quality of the sampling, of the data and of its compatibility. This supports the purpose of monitoring compliance with the MPL.

Currently the Technological Innovation (RM 621-2008-PRODUCE) that involves changing to indirect drying is almost completed. According to information from PRODUCE on 2010, 85 companies had met with this commitment. On the other hand the suitability to the MPL for the emissions is on adequacy until end of 2013.

2.4 HEAVY METALS

The mining companies settled in the Costa are related to the exploitation of mines located in the western Andes. These ones usually have their refineries, foundries and concentrators located in the coastal zone. Besides they located: maritime ports for the transport of the mineral concentrates (Company Southern Peru Copper Corporation); slurry pipelines and ports (Antamina, Huarmey, Shougang Hierro Peru); gas processing plants of the foundry of sulphuric acid production (Southern Peru Copper Corporation); shipping dock of polymetallics minerals in Callao; spring of shipment of iron ore concentrates and disposal of tailings at the coastal edge in Ica; spring and mining environmental liabilities in Ilo, and other more.

In total, there are about 8 mining or minerals companies processing as concentrators, refineries and steel industry. The increased production of metals in the coast area and western Andes correspond to: iron, zinc, copper and lead mainly.

2.4.1 Heavy Metals In Marine Environment

Heavy metals are one of the most dangerous environmental pollutants due to their toxicity; they are not biodegradable and potential to bioaccumulate in living organisms, amplifying its concentration in the food chains. Between them, highlighted by its toxicity and its increased presence in the environment the mercury, cadmium and lead.

IMARPE performs in bays and coastal areas regular monitoring of the concentrations of heavy metals in water, sediments and organisms. These assessments are part of the "Monitoring and Control Program of the Marine Pollution" of the Action Plan of the aforementioned stage of the CONPCASE III. According to INEI data, we can appreciate the ranges (minimum and maximum values) of heavy metals: Lead (Pb), copper (Cu), cadmium (Cd) and zinc (Zn), in superficial sediments of the Bays of Paita, Sechura, Chimbote, Huarmey, Paramonga, Supe, Callao, Cañete and Ilo; during the period 2001 - 2011.

Due to existing data is observed that in recent years at the Bay of Ferrol-Chimbote there is a decreasing trend in the maximum concentrations of heavy metals (Zn, Cu and Pb). Huarmey and Paramonga Bay presents high values of minimum and maximum concentrations of Zn; having the first one reached a peak close to 300 ug/g and the second one to 200ug/g in surface sediments in 2009. Also, maximum concentrations of Cu are above 50 ug/g, presenting a tendency to decrease, in both bays, from 2006 to the date.

In the Bay of Supe during the range of years 2001-2011 the values of Pb were almost nearly non-existent, however in 2006 there was a peak close to 200ug/g in surface sediments. The Cu presents a slight tendency to decrease from 2009. The Zn shows high values in its minimum and maximum concentrations, reaching peaks above 150ug/g for 2008 and 2009. While these values decreased in 2010, in 2011 they rise above 100ug/g in superficial sediments.

The Callao Bay presents excessively high values in all metals (Pb, Cu, Zn and Cd). The Pb came to have in 2001; a peak close to 500ug/g in surface sediment, and then was diminishing until 2011. Similar behaviour was observed with maximum concentrations of Cu. Moreover, the maximum concentrations of Zn arrived to have peaks in 2005 and 2006 near 700ug/g in surface sediment and close to 450ug/g in 2009. During 2011, there is a maximum concentration near the 300ug/g in surface sediment.

The Bay of Cañete shows high values of maximum and minimum concentrations of Cu and Zn. In 2004 the Cu presents a peak of about 100 ug/g, and then a tendency to decrease. While concentrations of Zn presents a peak in 2009 of approximately 150ug/g in surface sediment. For the 2011, was noticed a maximum value of Zn near 100ug/g.

2.4.2 Toxicological Assessments In Marine Organisms

IMARPE carried out bioassays or toxicity tests with different marine organisms that are exposed to elements or chemical compounds in different concentrations to obtain range of acceptable values.

That is why in 2009 tests of sublethal toxicity with cadmium on the sea urchin *Arbacia spatuligera*; to evaluate the effect of cadmium on the rate of fertilization was conducted. There was a median lethal concentration of 301.47 ug/L of cadmium with confidence limits

to 95% of 183.73 and 515.87 ug/L of cadmium. The NOEC value (No observation of effect of concentration) was 0.02 mg/L, which is the highest concentration of cadmium in which fertilization does not differ significantly with respect to the control. And the LOEC value of chronicity (Low Observation Effect Concentration) was 0.254 mg/L.

2.5 PERSISTENT ORGANIC POLLUTANTS (POPs)

Peru is part of the Strategic Approach for the International Chemicals Management (SAICM) led by UNEP, being the General Directorate of Environmental Health of the Ministry of Health, the National Focal Point. The aim is to achieve the sound management of chemicals throughout their life cycle. In such way for the 2020, chemicals could be used and produced in ways that minimize the adverse effects on human health and the environment. As part of the SAICM, the project "Safety Chemical" is carried out. This set up the updating of the "National Profile for the Evaluation of the National Infrastructure for the management of chemical substances".

2.5.1 Waste Assessments of POPs in Coastal Areas

IMARPE has made determinations of POPs (pesticides) present in sediments and bioaccumulated in soft tissues of aquatic organisms collected in the areas of Callao, Cañete and Pisco.

The program of pesticides monitoring of 2002 in Cañete valley, covered the determination of Aroclor 1254, 1260 and DDTs in sediments of the Cañete River, in marine sediments and in aquatic organisms. In *Cryphiops caementarius* were detected residues of DDT and its metabolite DDE (5.8 ng/g). The marine species *Mugil cephalus* presented maximum concentration of Aroclor 1254 with 28.96 ng/g and *Menticirrhus rostratus* a concentration of 11.81 ng/g of Aroclor 1260. The DDT was present in all its forms in each of the evaluated species (Cabello and Sanchez, 2006).

Subsequently, in compliance with the “Monitoring Program of Marine Pollution in the Southeast Pacific”, OEA Project - Panama, evaluations were conducted to determine the concentrations of POPs in bivalve molluscs from San Lorenzo Island, Callao, and invertebrates of Paracas, Pisco (Cabello and Sanchez, 2006).

The evaluation of Callao was developed in two seasons. The first season was in the beginning of the summer of 2005, which included San Lorenzo Island. In that occasion were collected *Semimytilus algosus* and *Argopecten purpuratus*. In the species *A. purpuratus* was found residues of DDT, as metabolites of p'p'DDE (<30,0 ng/g), (p'p'DDD (<20,0 ng/g) and p'p' DDT (<6,0 ng/g). The second evaluation was in the winter, July 2005. Assays with *Aulocomya ater were included* with the aim to evaluate the concentration of the residues of the group of DDT in both times of the year. The largest concentration of DDT was 30.7 ng/g. The recorded values were lower than the reference values established by the FDA (NOAA, 1990).

A third evaluation was undertaken during the summer of 2006. In this opportunity three species of rocky, sandy and stony substrate were collected: two of ecological importance (snails *Bursa ventricosa* and *Tegula atra*); and the third of direct human consumption (*Cancer setosus*). It was recorded a high incidence of the group of DDT (including its metabolites pp'DDD and pp'DDE) in the 3 species analysis. The highest concentration was

presented in the species *Tegula atra* (3.20 ng/g); besides low concentrations of pesticides Aldrin, Dieldrin and Endrin. Both snails presented other organic compounds. The DDT was recorded only in the crab. In none of the cases, the concentrations exceeded the international quality standards for aquatic products.

In August 2005, was assessed the presence of organochlorine residues in the species *Semimytilus algosus*, collected in the Ballestas Islands and the Ensenada Lagunillas, Paracas, Pisco. DDT metabolites were founded such as p'p'DDD in 34.8 ng/g and p'p' DDE of 7.9 ng/g. The values are lower than the FDA limits (<0.3 ppm ≈ 300 ng/g) for fish and shellfish (NOAA, 1990).

2.6. SOLID WASTE

ON average between 2001-2011, 80% of solid wastes were controlled in landfills, leaving 20% without being controlled. According to the data provided by INEI around 20% of the solid waste generated in the Province of Lima does not have a proper final disposal.

2.6.1 Marine Litter

Since 1999 the Organization VIDA - Institute for the protection of the Environment has been organising the International CleanUp Campaign of Coasts and Shores - Peru", as part of the "International Coastal CleanUp (ICC)" that promotes the Ocean Conservancy. This national campaign has been launched with the support of the Peruvian Navy, through the General Directorate of Captaincies and Coast Guard (DICAPI), and the support of sponsors and public and private institutions.

Over 14 years (1999-2012) during the “International Cleanup campaigns of coasts and shores – Peru”, 1 948 tons of marine litter have been removed from the shore by 68 394 volunteers. Thus, covering 1937.8 km in 48 445 km^2 of land. The year that was picked up the largest amount of garbage (16 %) was on the 2000 and the least amount (3 %) was during 2010. Furthermore, 2003 was the year where the greater amount of territory was cleanup (23 %) and the 2012 was the year with a higher number of volunteers (14 %).

The national totals by type of trash collected are shown in Table 02. From the national totals of the marine litter collected 55% was plastic, more than one million 200 thousand units listed. The second type of material more founded was foam with the 12%, whereas wood reached 11%.

Over the years, the presence of the plastic has varied. At a national level in 14 years 338357 units of PET bottles had have collected, which make an approximate weight of 16.9 TM. Moreover 254512 units of plastic bags were recollected, which make an approximate weight of 12.7 TM. The increase of wood as a residue is since 2008 until the 2011. Coincidentally, the construction sector increased during those years. The wood could be as a consequence of demolition of old houses.

In 2012 participated 9551 volunteers who collected 188 913 kilograms of waste in 180.35 kilometres of beach. The presence of plastic was 45 %, followed by the wood (14 %) and the paper/cardboard with 11%. The 56% of the collected is related to Shoreline and Recreational Activities (food, clothing, technology, etc).

Table 01. Total Results of 14 years of Clean-Up Campaigns, 1999-2012

Year	Solid Waste (tn)	Beach Cleanup (km)	Nº Volunteers
1999	132,5	289	8400
2000	302,4	47,8	5948
2001	127,2	422,2	4877
2002	103,6	296,1	4792
2003	126,7	438	6217
2004	210,4	24,6	4500
2005	202,4	21,4	5000
2006	60,2	5,9	2000
2007	102,5	41,5	2500
2008	73,5	49,5	2200
2009	163,4	13,9	4078
2010	51,8	17,9	3032
2011	102,5	89,7	5300
2012	188,9	180,4	9550
TOTAL	1948	1937,9	68394

Table 02. National totals by type of trash collected during 14 years of Beach Clean-Up, 1999-2012

Nationals Totals 1999 - 2012		
Type of Wastes	**Unites Recollected**	**Percentage %**
Plastic	1267842	55
Styrofoam	268668	12
Glass	125960	5
Paper	175677	8
Fabric	44544	2
Rubber	61695	3
Metal	119637	5
Wood	254825	11
TOTAL	2318848	100%

2.6.2 Construction and Demolition Waste Industry

On 7th of February of 2013 was approved by Supreme Decree 003-2013-VIVIENDA, the Regulations on the Administration and Management of the waste of construction activities and demolition. The diagnosis of construction and demolition waste (C&DW) of the year 2008, points out that 62% of the municipalities in Metropolitan Lima, recognized the existence of critical points in their jurisdiction. However in this study C&DW were not quantified, or analyzed at the coastline. Currently the Plan of incentives to the improvement of the Management and Municipal Modernization of 2013 has raised two goals related to the C&DW, the goal 09 and the target 32. The first goal is the identification, quantification and classification C&DW deposited in public spaces. Which must be respected and implemented by "main cities of type A' (Chiclayo, Trujillo, Metropolitan Lima, Callao, Arequipa and Tacna), according to the Annex N° 01 of the S.D N° 002-2013-EF for July 31st, 2013. The second one, goal 32 requests to have a waste management plan for the construction and demolition deposited in public spaces and minor works. The latter one must also be fulfilled by the major cities of type A, before December 31st, 2013. The Office of the Environment from the

Ministry of Housing, Construction and Sanitation is responsible for verifying compliance of the goals.

2.7 HYDROCARBONS

The Oil activity in Peru includes operations of exploration, exploitation (at sea and on the continent), processing and distribution; and is carried out on the coast and in the Peruvian jungle. On the coast, the largest extractive activity is performed in the northwest zone in the coastal strip and continental shelf. In the Talara Province in Piura Region there are the petroleum centres La Brea, Parinas, Lobitos, El Alto, Talara and the organs. Peru began the 2011, with 100 contracts for exploration and exploitation of hydrocarbons, being a sign of the interest growing of investors.

2.7.1 Oil Spills

The sources of marine pollution by hydrocarbons are: download from earth (urban and industrial waste, rivers, etc); operations on ships (cleaning, waste, etc); accidents in transport; atmosphere (incomplete combustion, evaporation and further deposition); natural (leaking and erosion); and Oil Rigs.

The Directorate General of Captaincies and Coastguard (DICAPI) is responsible for the administration of the international convention MARPOL 73/78. The compliance control is carried out using the monitoring units by air and earth during the voyage of the ships, in order to detect any form of unauthorized downloading. In case of oil spills and other pollutants, DICAPI, is the highest body that runs the National Contingency Plan.

In Peru the marine pollution by hydrocarbons is mainly attributed to the internal transport of oil, carried out mainly by sea and by accident due to poor or obsolete infrastructure. According to the National Port Authority (APN) from 2007 to 2012 there have been 19 oil spills. Nevertheless, according to the information provided by DICAPI reported that from 1999 to 2012 there have been 65 incidents of oil spills and other pollutants. During 2008 was reported a maximum of 8 spill incidents. During these 14 years, the harbourmaster of the Port of Callao reported 20 oil spills and other pollutants while the Captaincy of Talara had 14 spill incidents.

2.7.2 Hydrocarbons In Sea Water Surface

In fulfilment of the Monitoring Program of Petroleum Hydrocarbons that performs the IMARPE analysis were done in arrays of marine water and sediment during the years 2009 and 2010, in the coastal areas of the Callao, Cañete, Pisco, Huarmey, Paracas, Sechura, Supe and Talara.

Petroleum hydrocarbons in sea water in the Peruvian coast, between 2009 and 2010, reveal concentrations very influenced by the oil activity as is the case in the bay of the Callao (3.74 and 1.12 ug/L), Pisco (0.96 and 0.68 ug/L), Sechura (0.73 and 0.79 ug/L) and Talara (0.73 ug/L). The total aromatic hydrocarbons (T.A.H) for the period 2009 - 2010 in marine sediments along the coast of Peru, from bays with diverse oil activity, indicates values of pollution below the established by SQAGs, (Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters, 2000) that corresponds to a concentration of 16.8 ug/g.

In the Bay of Callao, during the monitoring done in March and October 2009, the average concentrations in sediment were not greater than 0.86 ug/g, with a specific concentration of 5.94 ug/g (March 2009), opposite to the rada of Callao, where is has a strong maritime traffic. In April 2010 in this same point was found high concentrations that reached the 46.15 ug/g, but the average concentration was 4.91 ug/g (Sánchez, G. 2010).

2.8 PHYSICAL ALTERATION AND DESTRUCTION OF HABITAT

2.8.1 Constructions

Seaports are located in protected bays. Nowadays it is allow the entry of vessels of large tonnage to most of the bays due to the fact that exist a current demand for transport of different types of inputs. Taking into account the main constructions carried out the last years along the coast, 52% are jetties, 22% breakwaters, 15% are platforms and 11 % other constructions. These structures cause severe impacts to the coastal strip, when they are based on bad designs, without studies of currents, tides, geomorphology of the coastline, as well as evaluations of the ecosystem of these geographical areas (Sánchez. G, 2010).

2.8.2 Case Studies

The Direction of Hydrography and Navigation of the Peruvian Navy has carried out work related to the development of the coastal profile, product of the oceanographic conditions of a given area of study. For this purpose, it is used numerical models of currents, waves and sediment transport, which allow to identify the main processes of erosion and sedimentation product of natural evolution or under the influence of the construction of coastal structures.
The variability studies were carried out in coastal Bay El Ferrol (2007- 2008), La Punta-Callao (2008), Miraflores Bay - APCV Project (2009 - 2010).

2.9 MARINE NOISE POLLUTION

Marine noise pollution is referred in the framework of International Law: UNEP, IMO, the Convention on the Law of the Sea of the United Nations (UNCLOS), the institutions of the European Union as well as OSPAR, ACCOBAMS, ASCOBANS, International Whaling Commission IWC, the Convention on Biological Diversity CBD, etc. In these texts and resolutions is reflected a concern about the impact of non-regulated marine noise pollution, and the precautionary principle is invoked, as well as the implementation of mitigation measures of the impact. Peru as a member of the Convention on Biological Diversity is subject to take into account the issue of marine noise pollution and develop measures to control and mitigate this particular topic.

III. LEVERAGE POINTS

Not only was identified the problems relating to pollution and health of the HCLME; but also the leverage points for each one of them. The problems identified are:

- Nutrient Enrichment / Eutrophication
- Pollution due to microorganisms
- Polluted beaches
- Pollution due to Marine Litter
- Pollution due to heavy metals

- Pollution due to pesticides
- Pollution due to Persistent Organic Pollutants (POPs)
- Pollution due to Hydrocarbons and derivatives of petroleum
- Noise Pollution
- Physical Alteration and Destruction of the Habitat

During the Causal Chain Analysis (CAA) workshop of May 2013, of all these 3 problems were prioritized: Pollution, Biodiversity Loss, and Physical Alteration and Destruction of Habitat.

The immediate causes notice for these 3 priority problems are: erosion, sedimentation, construction, dredging, warming sea temperatures, sea level rise, loss of marine and coastal ecosystems, domestic sewage, industrial effluents, emissions, ballast water, oily mixtures, solid waste, watersheds and river mouths of polluted rivers, noise pollution and eutrophication.

The policies or management instruments also called mitigation actions identified for these above mentioned immediate causes, common to the three priority issues were:

- Development, revision and approval of EQSs and MPLs.
- Build up regulations that establish that the managers use laboratories whose limits of detection are comparable with EQSs and MPLs.
- Inclusion in the Environmental National Fund (FONAM) of a Fund for Laboratories Credit. In order to strengthen the technologies of the laboratories used for environmental analysis.
- Effectiveness in environmental supervisions and audit, based on documentation of the evidence.
- Creation of regulations that establish the obligation to implemented an Environmental Management System (EMS) by the administered.
- Investment in research (basic and applied), development and innovation (RDI).
- Implementation of environmental education in different levels of the education system (primary, secondary and higher).
- Development of socio-economic investments based on the Carring Capacity of the coastal and marine ecosystems.
- Incorporation of integral valuation (economic, social, cultural, others) and a compensation for environmental services of the marine and coastal ecosystems.

To prevent the degradation of the marine environment will be more useful a strategy of precaution and prevention that reaction. This requires, among other things, the adoption of precautionary measures, environmental impact assessments, and investments in eco-efficiency production processes, recycling, environmental audits, and waste minimization.

IV CONCLUSIONS AND RECOMMENDATIONS

1) The Humboldt Current Large Marine Ecosystem (HCLME) is one of the most productive systems in our planet. It depends on the upwelling phenomenon that provides nutrients to surface waters, where large communities of phytoplankton are developed. These populations are the basis of an ecosystem that has an impact on the marine life across thousands of kilometres of the Southeast Pacific.

2) Very little is known regard the variability of the Oxygen Minimum Zone (OMZ) in the upwelling system of the Humboldt Current. Although there are studies about the OMZ most of there have mainly focused in the changes that occur during the ENSO cycle. The studies on the variability of the depth of the upper limit of the OMZ and its thickness are key indicators for the biogeochemical changes, which might in some future help studies of environmental quality.

3) The information about the surface currents help in the study of the oceanographic problems related to human activities. Studies linking marine currents with pollutants should be carried out.

4) Existence of uncertainly of the effects and impacts of the climate change in the behaviour of the marine-coastal ecosystem. Therefore, facilities for the development of research on the subject are necessary.

5) Although in Peru we have Algal Blooms, until now they haven't been harmful. That is why a permanent and continuous monitoring of potentially toxic phytoplankton species is necessary. Moreover, a multidisciplinary approach of oceanographers, physicists, chemists and biologists (taxonomists, ecologists, etc.) is required to allow a quick detection, early warning system and prediction of the presence of these organisms, in order to develop contingency plans and for applying mitigation strategies in affected areas.

6) During recent years marine pollution has held steady and in some cases, (it) has increased. To mitigate and control the impacts of marine pollution originated from land-based sources, it is necessary to identify the type and level of pollutants, the identification of the sources, the volume of waste, the concentration of potential pollutants and the localization of discharges, evaluating those sources as an essential element for the application of meaningful mitigation actions.

7) The eutrophication process due to the high levels of nutrients (mainly nitrates and silicates) resulting from urban and farming sewage; is present on the Bays of Callao and Huacho. It is known that the Bays of Paracas and Chimbote also present higher values of nutrient concentration.

8) The pollution due to organic matter is present in several bays of the Peruvian coast. According to the data of DBO_5 of recent years, almost all bays analysed presented concentrations exceeding the accepted by regulations. However, an interesting case to mention is that the Bay of Ferrol-Chimbote, despite of presenting higher and non-acceptable concentrations, has a tendency to decrease, which shows the positive influence of the APROFERROL project.

9) Peru has very strict sanitary controls and requirements for its hydrobiological products to be exported, as for the facilities in which they have been treated and also throughout their supply chain. However, the controls for the internal market are not so strict. Likewise, at the moment, most of the landing sites do not accomplish with the sanitary regulations, reason why is necessary to invest in technological, financial and human resources in order to counteract this situation.

10) The Health Ministry jointly with the Vice-Ministry of Fisheries of the Ministry of

Production should cross-check the information and work together in order to obtain a unique register of pathologies and diseases originated by microorganisms or other sources found in marine environments that affect its quality, the one of its resources and that can affect the human being.

11) Notwithstanding there is an International Ocean Health Index (OHI), which should be used only as reference point, and exist at a national level a Sanitary Beach Classification Index; a unique index for the HCLME should be created. This new index for the HCLME should be useful as an indicator of: health and environmental quality; sustainability; and management status (wherein an ecosystem approach should be consider) of the marine ecosystem. Ideally, it should be sensitive to adapt to limitations (or future improvements) of the availability, quality and quantity of data. It should also have a Strategic Action Programme.

12) In the last decade, the creation of the Ministry of Environment and its offices, as well as the creation and entry into force of environmental regulations give a solid legal framework for a correct management and governance with an ecosystem approach of the HCLME. The enactment of the Environmental Quality Standards as well as the Maximum Permissive Limits, help legislate aspects of activities in different sectors. However, there are some inaccuracies in the EQSs (e.g. the EQS for soil does not specify whether it is considered the subsoil, seabed, the ground of the coastline, etc.) and a lack of standardization of MPLs by sector, considering the marine environment (e.g. MPL for the effluents of the activities of generation, of transmission and of distribution of electrical energy, allows the discharges into the ocean may have up to 49°C of temperature, while the MPL for the temperature of the effluents of fishery industry are not specified, and the non-correspondence with the EQS for water, which mentions a delta of 3°C for conservation of the marine environment).

    It is concluded that there is a limitation of observation of the trans-sectoral and sectoral regulations, which must be minimized. It is recommended to assess the proper applicability of the Environmental Quality Standards for a particular use, without contradicting other valid standards. Additionally, it should be standardized the criteria for assessment the water quality in coastal marine areas.

    Moreover, It is important to prioritize the scientific research and analysis in all aspects, levels and sectors. In this way to be able to count with scientific information that endorses the determination, realization and/or modification of the Environmental Quality Standards, the Maximum Permissive Limits, as well as other guidelines and directives of environmental regulation.

13) The environmental control system (evaluation, monitoring, supervision and sanctions) should pursue new measures to ensure that the evidence of pollution can be documented; and that the administrators of the different sectors do not repeat environment breaches.

14) In the last years, the strandings of dolphins, sea lions and birds has increased throughout the entire Peruvian coastline. At the same time, the citizens started worrying more about this phenomenon. Even though the origins of the latest strandings were different (due to lack of nourishment, poisoning and even for unknown reasons), a more suitable and convenient scientific research is needed.

15) The MARPOL 73/78 Agreement guarantees that the port terminals in Peru, as well as the installations for repair and maintenance, include adequate facilities and/or reception services for all kind of wastes coming from ships, in order to avoid the pollution on the marine environment. To date, 18 port facilities of different administrators nationwide have an Environmental Management System (EMS), 10 of which have ISO 14001:2004 and 7 are in process of implementing it.

16) The General Directorate of Captaincies and Coastguards (DICAPI) in association with IMARPE, in partnership with IMARPE performs activities to establish protocols for sampling and analysis within the context of the Ballast Water Surveillance Programme. The following management measures are suggested: to identify nationwide ports with greater influx of vessels and in which it is reported a greater number of changes of ballast water in it jurisdiction, in order to be able to take preventive measures. It is also necessary to continue promoting the sampling and analysis of the ballast water and sediments found in the ballast tanks of the ships that arrive to Peruvian ports and set up land facilities for ballast water treatment. Thus, it is must to have a database of the findings that are conducted on the subject.

17) The monitoring reports on water-quality of the Bays of Paita, Sechura, Santa Rosa, Coishco, Ferrol-Chimbote, Samanco, Tortuga, Huarmey, Supe-Paramonga, Huacho, Chancay, Lima-Miraflores, Callao, Cañete and Pisco executed by IMARPE during 2006 – 2011 for determining the pollution due to urban sewage, results that the maximum concentration of thermotolerant coliforms in extremely high, beyond the maximum accepted for water by the EQS. In most cases, the lack of sanitary education of the population living on riverbanks produces pollution of the rivers, given that they throw solid and liquid wastes that cause the increase of fecal microorganisms. This is the case of the Bay of Callao in where the data shows that the concentration of the pollutants remains high in the course of the years.

18) Since the beginning of 2013 the Wastewater Treatment Plant (WWTP) Taboada is in operation. With this plant is expected minimize the health problems of the dumping of 8 direct collectors (drainage) of Metropolitan Lima that discharge in the sea and in the Rimac River without any treatment. The WWTP La Chira will join this project on 2014. However the main problem that affects the efficiency of the WWTPs is the income of industrial effluents in the sewerage system, whose organic load and other elements such as heavy metals, acids and bases that generate overload on the treatment units and adversely affect the biological processes of debugging. Because of this, the creation of MPL for discharges of industrial effluents to the sewage system is a must.

    It is recommended to promote technological research and to have sources of financing available and specific investments in wastewater treatment. Furthermore is recommended the execution of a General Guidelines Proposal for a National Program.

19) Currently, industrial fishing facilities and new or relocated processing plants are in process of adapting to MPL for the effluents coming from the fishmeal and fish oil industry approved by D.S 010-2008-PRODUCE. Regarding the emissions, until 2010, 85 enterprises fulfilled the technological innovation commitment and were aligning itself to the regulations of D.S. 011 - 2009 – MINAM, which establishes the Maximum Permissible Limits (MPL) for emissions from fishmeal and fish oil industry and flour of

hydrobiological waste.

20) Within the context of the Monitoring and Marine Pollution Control Programme of the Action Plan in the referred stage of the CONPCASE III, IMARPE has conducted regular monitoring of heavy metals in trace in seawater, sediments and organisms within bays and coastal areas. According to the data obtained from heavy metals, the existence of point-source pollution in superficial sediments, mainly in the Bay of Callao, by lead, copper and zinc in was confirmed. There was no data on the concentrations of heavy metals in trace in the seawater in order to compare them with the EQS for water.

21) The Petroleum Hydrocarbon and Pesticides laboratory of IMARPE is part of the Monitoring and Marine-Coastal Management Unit and performs evaluations in compliance with the commitments of the Stockolm Agreement, like the assessment of Persistent Organic Pollutants (POPs) – including polychlorinated biphenyls PCB – and organochlorine pesticides in sediment and marine organisms. Presently POPs analysis carried out by IMARPE is on stand-by because the technology used is damaged.

    Because of this, it is necessary to mention that the laboratory infrastructure should be increased for the analysis of Persistent Organic Pollutants nationwide. Moreover, the awareness on the importance of the management of chemicals substances (pesticides, fertilizers, dioxins, furans and other POPs) should be strengthened and enhance information on the management of these substances. Even though the current environmental legislation is extensive and the majority of environmental regulations consider the subject, there are non-clear oriented approaches to the prevention and control of its environmental pollution and there is still evidence of legal gaps. In addition, there are weaker mechanisms for regulation and punishment.

22) In the last 14 years, from 1999 to 2012, 1 948 tons of waste have been removed from the Peruvian marine ecosystems, from which 55% were plastics (mainly plastic bottles). The second type of material found was foam registering 12%, and wood, 11%. For 2012, data showed that 56% of recollected wastes were related to shoreline and recreational activities (food, clothing, technology, etc.).

    The 2008 diagnose of construction and demolition wastes (C&DW), shows that 62% of the local governments of Lima Metropolitana, knew about the existence of critical points in their jurisdictions. At the present, there are no public nationwide studies about the environmental impact of C&DW in the marine environment. A coordinated management among the coastal municipalities of the province is required, for the adequate management of solid wastes (final disposal) and for avoiding their disposals throughout the coastline.

    It is also recommended further research regarding the presence of plastic particles in the water column and its impact on organisms. Furthermore it should be developed researches regarding waste quantification in the marine environment, and the description of its distribution through the marine currents

23) In the last years, the number of contracts of oil industry, including the exploitation, and oil exploration in the continental shelf, has increased. Also, the number of boat-landing sites, mooring, ports, etc. increased nationwide, which increase the internal transportation of petroleum within Peru. This entails to increase the risk of pollution of

the marine environment by hydrocarbons and the affectation of its organisms.

That is why, the determination of Maximum Permissible Limits (MPL) for Total Hydrocarbons (TH) and Total Aromatic Hydrocarbons (TAH) in water, sediments and marine organisms is required, in order to guide the interpretation of the results of the analysis carried out.

24) It is recommended, that in order to determine the biological responses of marine organisms exposed to environmental chemicals (metals, TAH, POPs, pesticides, etc.), as well as the level of harmful or lethal effect generated by exposure, should be performed Environmental Bio-monitoring or Ecotoxicological assays (using biomarkers) in bio-indicator organisms of the evaluation area. Also, seeking to identify the risk of bioaccumulation of chemical compounds in marine resources. Likewise, investment in research (basic and applied), Development and Innovation (RDI) on marine pollution subjects is necessary.

In order to mitigate the environmental impacts of the projects of different sectors, it is suggested that during the preparation of the Environmental Impact Assessment (EIA) a quantitative methodology should be used to assess the impacts.

Another point to take in consideration is to build up regulations that establish that the managers use laboratories whose limits of detection are comparable with EQSs and MPLs. An alternative to facilitate the development of this could be the inclusion of Environmental National Fund (FONAM) of a Fund for Laboratories Credit. In order to strengthen the technologies of the laboratories used for environmental analysis.

25) In the last decade, a construction boom of mega ports and other maritime infrastructures have been observed along the coast of the national territory.
It is for this reason, that national policies for management of the ports are needed, where should include the control and prevention of coastal erosion and sedimentation due to anthropogenic factors related, among other reasons, with techniques and practices of land use and construction.

26) The current knowledge of the effects of noise pollution on marine fauna is incomplete and not totally known. The delay in the existence of regulations for the control of marine noise pollution in the Peruvian sea is the result of the ignorance about the traditional use of sound by the marine fauna and its functional role in the aquatic ecosystem. Moreover, joined to the fact that the subject is not prioritized.

It is proposed: the development of national guidelines in order to mitigate the effects of underwater/submarine noise on the marine environment; the requirement of authorization for the installation of echo-sounders in ships able to emit frequencies less that 200 kHz; the control of noise levels in marine protected areas; the prohibition of repetition of geophysical samplings developed by different companies, with the same aim in a particular area; and the creation of a database for acoustic information regarding of the seafloor of the Exclusive Economic Zone (ZEE).

It is also suggested, a quantification of the sources of marine noise pollution in the Peruvian sea, as well as a description of its spatial and temporal extent. These subjects could be a good starting point for scientific research.

27) Development of socio-economic investments according to the carring capacity of the marine and coastal ecosystems.

28) Incorporation of integral valuation (economic, social, cultural, others) and a compensation for environmental services (soil protection, sedimentation, basins, oxygen generation, capture of CO_2, recreational areas, Natural Protected Areas -NPAs and wild natural ecosystems) of the marine and coastal ecosystems.

29) To establish economic incentives, to implement clean and eco-efficient Technologies. Also to constitute other ways commensurate with the incorporation of environmental costs, in order to avoid degradation of the marine environment.

30) Incorporate environmental education into the different levels of the education system. As well as, to promote the introduction of marine environmental protection themes in the marine and fishery study programs.

31) Optimize the inter-agency and intersectoral exchange of information. This swap should be coordinated in order to be simplified, fast and clean. Thus, the strengthening of the management m

32) Due to a lack of incentives and of environment commitment of the companies and of public and private institutions for a development environmentally favourable, it is proposed the creation of regulations that establish the obligation to implement an Environmental Management System by the administered.