METHODOLOY OF POLLUTION'S ANALYSIS OF INSIDE THE BAY WITH PORT

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ABSTRACT

This paper present a methodologies used to determine the transport of pollutants in aquatic environments and analysis of social, economic and environmental use, traditionally, well-established statistical techniques, such as analysis of variance, hypothesis testing of models, linear or multi-criteria analysis. But these methods do not allow us to assess how the phenomena described by distributing data on the geographical area, how computational tools of representation and analysis of geographic data, or *Geographic Information Systems - GIS*. They are currently being used for the treatment and analysis of these data and applied in various areas of knowledge, whether in health, environment, agriculture, fishing, sea culture, oceanography, among many others. The physical survey was carried out from February 2007 through May 2008 for proof of the methodology presented here.

1. Introduction

The globalization of the world economy more internal economic development is promoting growth in many countries. This need to be developed economically and socially in most cases leads to the exploitation of new sources of funds, exerting strong pressure on the environment. Production processes based on the destruction of the environment, usually have generated damages whose costs are vastly greater than the benefits obtained. In this case, the fall in aquaculture products can demonstrate the cost of environmental degradation of coastal mangroves and the reductions in economic productivity due to scarcity contamination of water resources show the impact of the loss of those resources and the natural decline in productivity.

The areas most sensitive to anthropogenic phenomena are the coasts. The estuarine areas, the mangroves, corals and the bays are the places of procreation of the vast majority of marine fauna. Just then, these rich marine environments, is that they are the biggest pollution effects, because it is where are the toxic waste dumped directly from coastal cities, the numerous industries and agriculture, including often brought from great distances by rivers that flow in these places. .

The transport and dispersion of pollutants in natural water courses are usually described by a one-dimensional model, in the form of differential equation known as advection-dispersion equation, deduced from a balance of mass, where the flows are governed by the law of Fick [1].

The hydrodynamic is the main driving force for the transport of chemicals substances (pollutants, nutrients), biological (phytoplankton, zooplankton) and geological (sediment). And to understand that we must learn some important concepts related to the distribution and transport of pollutants in an aqueous environment. A pollutant, when receiver gets into a body he is a bay or estuary, is controlled by hydrodynamic from the encounter of the amount of sewage flow to the ocean, under the influence of tides, distributed of two phases, dissolved and particulate.

The particulate phase is linked to particulate matter and may therefore ultimately be deposited in the fund, taking it to its final destination, or if reverse suspended the sediments, to be mobilized for the water column.

The dissolved phase circulates in this environment, depending on the balance with the particulate phase, and may receive significant contributions from interstitial waters contaminated by the concentration of pollutants in the bed of sediment, and then directed at depths greater.

In addition to the environmental pressures that result in changes in the physical environment, some most striking effects of different human

activities are the social and environmental conflicts. Lack, grace and / or an inadequate environmental legislation disseminated socio-environmental problems. Activities of mining, logistical structures, industrial complexes, ports among others, are sources of many problems, most of them associated with the occupation and ownership of resources and other due to the effects inherent in the production.

The environmental sustainability is now a major concern of society, whether in the political environment, social, academic and economic. This new reality has led to demand for a variety of techniques which have the order preventing, controlling and even recover environments that have been subject to deterioration and impacts resulting from human activities. In this work, we will deepen the study of the Bay of Paracas-Pisco, Peru, and an area in which it is mixed in character interests of economic, political, social and environmental.

The Paracas Pisco Bay , is located between the coordinates 13 ° 46 'S - 76 ° 16' W and 13 ° 50 'S - 76 ° 30' W, the temperature in the region ranges from 15.5 ^{o}C and 18 ^{o}C in winter and 20 ^{o}C and 25 ^{o}C in the summer, presents a 2 mm average rainfall per year. The geological characteristics of the region and the current presence of Humboldt have favored the establishment of various communities of flora and fauna. The high productivity in the waters of the bay, and variety of natural conditions makes the bay an oasis in the desert of the Peruvian coast, where there are approximately 216 species of birds, 168 species of fish, 16 species of mammals, 10 species of reptiles, among others bird species both locals and migrants.

The Bay of Pisco has suffered a series of changes in the natural landscape caused by economic development due to the action of the fishing industry, (Industrial fishing Park) and energy (Porto San Martin and gas fractionation plant in Camisea). To protect these areas, it is necessary to understand the natural vulnerability, its economic potential, identify and quantify the environmental aspects and impacts, aiming to select mediated to be implemented in order to ensure sustainable development.

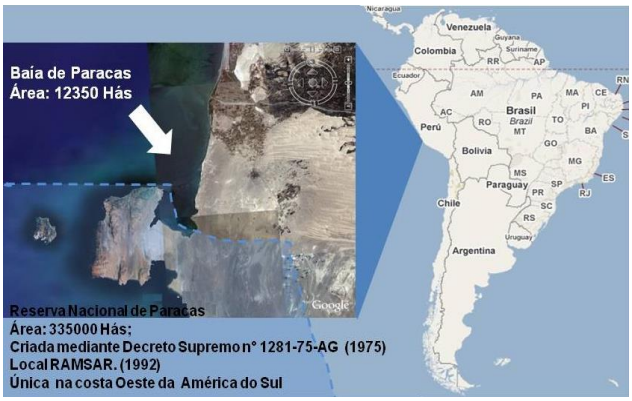

Fig.1 Location of the Bay of Paracas-Pisco

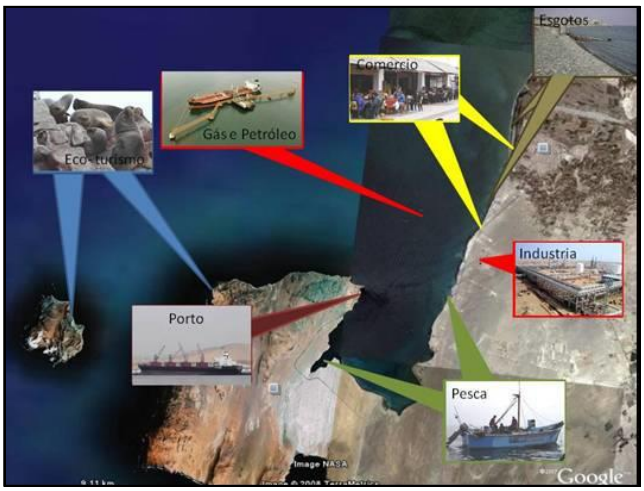

Fig.2 Area of study- Bay of Paracas-Pisco

2. Purpose

The main objective of present research is to evaluate the environmental aspects and impacts generated by activities in the Bay of Paracas-Pisco. As well as, to determine the dynamics movement of pollutants inside the bay.

3. Development of the Research

Considering the absence of the need and importance of a database organized on the area in question, it is necessary to carry out the characterization, analysis and a conceptual proposal of ecological-economic zoning, thus providing a geo-referenced database, in view to identifying the degraded areas and occupied by various anthropogenic activities. This line of action is a planning tool that generates indicators on the strengths and weaknesses of physical resources, biotic and socio able to support decision making, serving as a liaison to the public and private actions, according to the needs,

conservation, protection, rehabilitation and socio-economics [2].

With the advent of computers, emerged several tools for capturing, processing and presentation of geographic information. The connection of these technical and conceptual tools led to the development of technology for processing spatial data, called Geoprocessing. *Geographic Information Systems (GIS)* are information systems specially built to store manipulate and analyze spatial data, i.e. data that represent objects and phenomena in which the location is an inherent characteristic and indispensable to treat them.

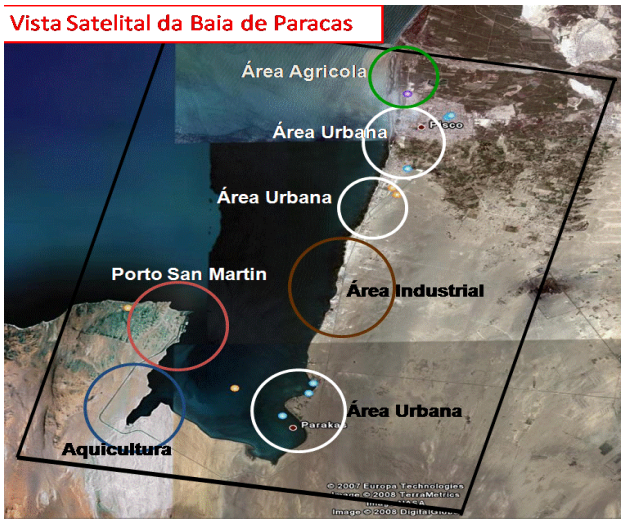

Fig.3 Human activities in the Bay of Paracas-Pisco

Using the methodology of ecological-economic zoning, offers several advantages, some advantages are described in further:

• Increased ability to integrate disparate data and information sector;

• Ease of reading and interpretation and easy access to information;

• Harnessing the experiences accumulated in the institutions as the Zoning;

• Greater transparency in diagnostics and propositions;

• Integration inter-institutional materializing the new style of planning.

To develop the work using the *Google Earth* platform, and the program *SAGA GIS* (*Automated System for Geo scientific Analysis*) that is a hybrid program. This aims at to carry out the crosses of different thematic maps, in order to identify the areas in certain regions. With these criteria could define the following areas for action:

• *Zone early* - this area consists of natural areas where human intervention has been small or minimal.

• *Zone extensive use* - consists mainly of natural areas, but may contain some areas of human change;

• *Agricultural Area* - area devoted to cultivation of agricultural products;

• *Industrial Area*- area dedicated to production of new items is characterized by the presence of little villages.

• *Use of Special Zone* - the area belong to the areas necessary for the administration, maintenance and services of the Office of Conservation;

• *Urban Area*

The satellite photos and maps used in the research allowed the visualization of areas under different anthropological activities, including urban development, industry, agriculture, aquaculture, transportation among others.

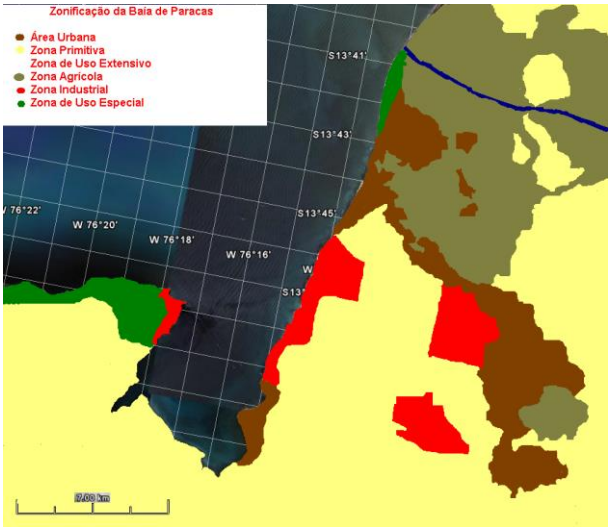

Fig 4 Ecological-Economic Zoning of the Bay of Paracas

From this perspective, it should be understood that maps and photos are not only cartographic products which are recorded and stored information, but instruments of research that serve as support for the planning of adequate space. The geo-technical reference allows a greater knowledge of the natural environment and human action, allowing the analysis of changes and environmental imbalances over time. Another fact

that justifies the adoption of this methodology is the absence of studies and research of this kind in the region, especially when it involves environmental issues.

The processing of images has also characterized the reference points to collect samples of sea water for later analysis in the laboratory. The points of data collection on the depth study and analysis of water quality was done in 3 areas which were divided respecting the physical, human activities and developed their characteristic political and economic (municipality). The mapping for data collection was as follows:

a) *Inside the bay* - This area is the portion of water surrounded since the "Punta del Pejerrey" where is located the port of San Martin (13 ° 47 '32 "S, 76 ° 15' 26" W), beach "Media Luna," beach "The Chaco," beach of Paracas have an 58 km2 of extension. The underwater area is the most varied in relation to the others. In front of Punta del Pejerrey, presents a rocky area where the port is located San Martin and a pending 10/100, robust presence of seaweed, crustaceans and fish. Front of the wharf company's EPSEP- Empresa Peruana de Servicios Pesqueros del Peru, there is presence of corners rotated diameters ranging from 8 to 12 cm, and strong presence of material result of the decomposition of limestone shells. There is a strong presence of small-sized vessels, 70% of artesian fisheries, transport for 23% and 7% of tourists for leisure.

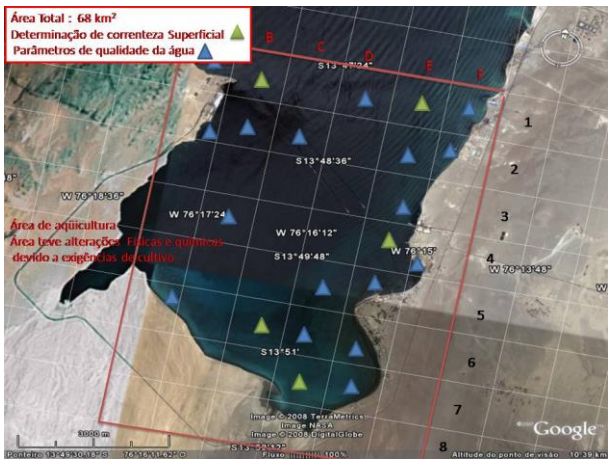

Fig.5 Points for data collection inside the Bay of Paracas-Pisco

b) beach of San Andrés- This area is located opposite the municipality of San Andres, is an extension of 68 km2. The platform provides an outstanding submerged very low, approximately 10 cm / m which descends to the beach within 2 km. Since the 2,000 meters, the outstanding amount to 20cm / m. It has an irregular coastline, circumvention of sand and turned corners. In the same area is the terminal of oil from San Andrés, which has capacity to store 365,000 BLS / year of hydrocarbons highlighting: gasoline, diesel, kerosene, among others. The oil terminal is supplied through a submersible platform, this area is the visible presence of oil on the surface of the water and waste oil came on. A 4 km from the oil terminal toward the South is located at the industrial zone of San Andres and Paracas; in this area are down 7 companies dedicated to the production of fishmeal and fish oil with an average annual production of 404,000 tons of fish meal. This area receives a heavy load of pollutants; were identified 18 products, 12 of which correspond to effluent from the plant for processing of fish meal and oil, 4 other products correspond to the distribution system of gas fractionation plant in Camisea (Consortium Plus energy-petrol) and untreated sewage [2].

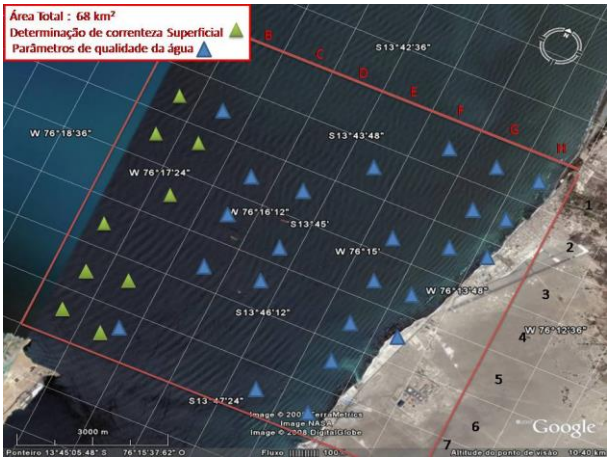

Fig.6 Points for data collection area of San Andres beach Lobeira

c) coast of Pisco- This area extends from debouchments (mouth /estuary) of the river to the port of Pisco Pisco toward SW. This region has a total area of 38 km2. The topography of the fund

gradually decreases from the submerged beach Lobeira (South), enough to achieve the 14 meters of the water column opposite the port of Pisco. Using the technique of diving, it was noted that the area presents a very bumpy surface, flat areas with low and rocky, it was found the existence of corners and run strong presence of seaweed, as well as material sedimentary. As Nautical Charter of the region, we have approximately 355 m SW in the dock of Pisco (13 ° 42 '57 "S, 76 ° 13' 31" W), the presence of two low of 4.5 meters and 1.83 meters in a area 500 m2. This area receives a heavy load of pollutants generated by the discharge of the two lagoons of stabilization, untreated sewage [4], as well as two streams from agricultural effluents in the region. In this area there is a strong presence of cargo ships, due to the presence of the port of Pisco.

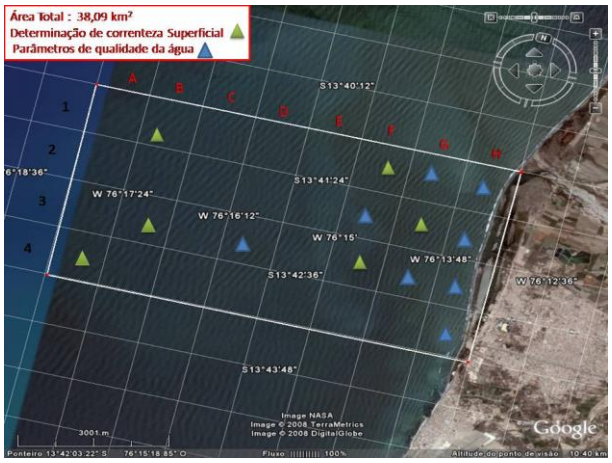

Fig.7 points for data collection before the beaches of Pisco.

The complexity of simulating the transport of sediment results from the large number of processes involved in the disposal flows (waves, tides, flow of rivers, wind), as well as the amount of phenomena in the integration of the flow and sediments (entrainment, re-suspension / deposition), and especially the interaction, nonlinear, and processes at scales of time and space very different. The tides and currents are the main physical parameters involved in the distribution of pollutants.

i) The tides

The action of the oil is regarded as an important physical factor for primary production and, together with other factors of smaller importance (winds, density, temperature, etc.). Influence ecological processes.

The importance of the tidal study based on the need to determine the heights and depths of topographical accidents for the design of structures in coastal areas. From the environmental point of view, has high biological interest, because it sets the boundary between the areas of terrestrial and marine species.

According to Direction of Hydrographic and Navigation of the Peru Navy, in the study were present tide of semi-diurnal type which have two phases: two high tides and low tides during the day to sail (24 hours and 50 minutes) . The extent of the media tide is 0.58 m, the breadth of the moon (full moon and new), also known as maximum extent of high tide width is 0.76 m. In the case of the presence of the phenomenon "El Nino", the value of the tidal level was increased reaching the scale of 90 cm.

ii0 Currents

The current speed and direction of the currents are the most important parameters of the hydrodynamic in the transport of pollutants and sediments and the basis for the development of programs to identify sources of pollution (Grafand r. Rosenberg, 1997). In the field of study exists only study of currents and bathymetry in a radius of 2.km adjacent to the port of San Matin. In that sense it was necessary to do a study on direction and speed of currents that circulate within the bay. The technique used was the use of floats attached to a candle submerged. The float is identified with the help of a small flag and surface area of the float on the water is kept as small as possible to minimize the effect of wind drag. The determination of the direction and speed of currents surface was performed using a float "Eva" synthetic material of 100 mm in diameter and a width of 80 mm with a capacity of up to 400 g suspend the float was at a weight of 1 kg with the objective to minimize the area of exposure to the wind. The speed of flow was determined after statistical treatment of 20 observations using the technique of linear regression.

The survey was conducted by Ecobatymetri Cure 242 - Eagle (portable). The location of the point of collection was done using a Garmin GPS Brand, model GPSMAP 76S. Data were corrected for the level of the flood. In figure can be shown from the depths in the bay.

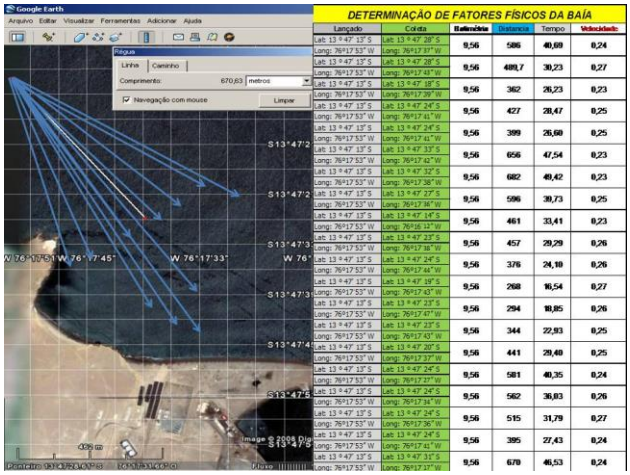

Fig.8 Determination of the direction and speed of currents

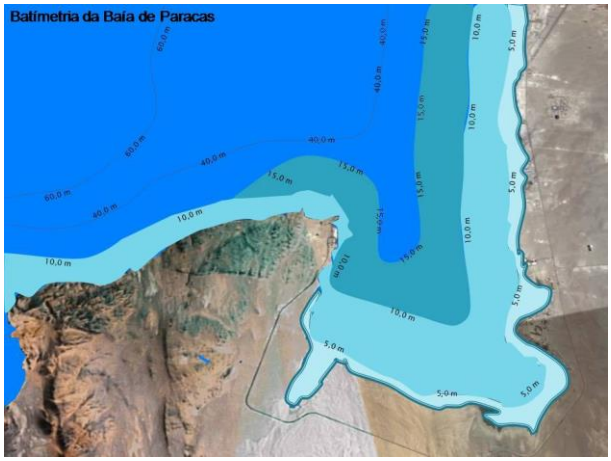

Fig.9 bathymetry of the Bay of Paracas-Pisco

In each of these items was also made the rising of the water quality parameters aimed to analyze the following parameters. PH, dissolved Oxygen, Biochemical Oxygen Demand, temperature, transparency, oils and greases. These parameters were obtained through multiparâmetro YSI 556 MPS in 2 depths. The first one: 0.5 m in the water depth and the second at 1 m from the benthonic bottom. The analysis of the information was made comparing the values allowable by law established the Environment of Peru, addressed the General Water Law of Peru, and approved by Supreme Decree No 261-69 AP at the time of 1994.

4. Conclusions

The methodology proved to be a basic tool to implement actions aimed at environmental management in the region.

The high levels of BOD, presence of anoxia, and fecal coliforms are the result of emissions of fishmeal factories, and low circulation of currents in the area, which undermine the power of self depuration the bay.

It has been proven the existence of the currents in the bay from a South which increased from 16 hours, with an average speed of 20 cm / s and another from Punta Pejerrey which enters the bay in the early hours of the day, falling sharply the 16:00 hour.

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