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Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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INTERNATIONAL CENTRE FOR SCIENCE
AND HIGH TECHNOLOGY

in collaboration with the

Institute of Marine Sciences and Technology, Izmir, Turkey

and the

**UNEP Coordinating Unit for the Mediterranean Action Plan
(MED POL Programme)**

COPIES OF SUBMITTED MATERIALS

Workshop on Industrial Pollution Assessment and Prevention in Mediterranean Coastal Areas

Izmir, Turkey
18-20 November 1998

INTERNATIONAL CENTRE FOR SCIENCE
AND HIGH TECHNOLOGY

Area Science Park, Padriciano, 99 - Building L2, 34012 Trieste, Italy
Tel: + 39-040-9228108, Fax: +39-040-9228136

Institute of Marine Science and Technology

Haydar Aliev Bulvarı Nr, 10, 35340 İnciraltı, Izmir, Turkey
Tel: +90-232-2785112, fax +90-232-2785082, E-mail: director@ imst.deu.edu.tr

Workshop on Industrial Pollution Assessment and Prevention

in Mediterranean Coastal Areas

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Evaluation and Closure of Workshop.

Welcome speech and presentation of IMST, Izmir, by Mr. O. Uslu, Managing Director of IMST.

The pollution of coastal waters is a continuously increasing concern for the mankind. Specifically, the industrializing nations around the Mediterranean Sea are experiencing severe environmental problems in their coastal zones since several decades. Hand in hand with this development the environmental awareness is developing in these countries in the last years.

Thanks to the international concerted actions to protect the Mediterranean environment the governments and authorities are feeling the obligation to spend more effort for the control and abatement of pollution.

Since the funds to combat pollution are generally insufficient, the starting point for these efforts should be the correct understanding of the environmental situations and remedies in order to optimize the scarce financial resources. This is a responsibility resting upon the shoulders of the scientific community.

The Institute of Marine Sciences and Technology of Dokuz Eylül University in Izmir Turkey has been working since more than two decades in the field of marine pollution with its experienced staff and facilities. It is a great honour and pleasure for the Institute to host this workshop and the highly qualified participants.

On behalf of the Institute I want to express my sincere gratitude to UNIDO for the generous support given for the realization of the workshop.

Words of welcome by Mr. G. Kamizoulis, on behalf of MAP; and, Mr. E. Feoli, on behalf of ICS/UNIDO.

Dr G. Kamizoulis, in his welcome speech on behalf of the Mediterranean Action Plan, stressed the need to give more attention to the industrial activities that can be a potential polluting source of the Mediterranean Sea. To this end he referred to the LBS Protocol of the Barcelona Convention, which is the legal tool for the Mediterranean countries for pollution control resulting from industrial activities in land. The Protocol gives priority to reduction of industrial pollution that is due to substances, which are toxic, persistent end liable to bioaccumulate. In addition to this, other activities related to the implementation of the mentioned Protocol have already started. In particular, he referred to the recently formulated Strategic Action Programme (SAP) to address pollution from land-based activities, as was adopted by the Contracting Parties in late 1997. SAP includes a very detailed programme of activities aiming at the reduction to the fullest possible extent of industrial pollution generated by industrial discharges in the Mediterranean Sea. The workshop is a good opportunity to discuss end exchange views on the problems related to industrial pollution.

WORKSHOP ON INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20 November 1998, Izmir-Turkey

Environmental Problems in the Mediterranean Coastal Areas as a Results of Industrial Pollution's

N.TAŞPINAR

Department of Civil Engineering Izmir, Turkey

Mr.Chairman, *Distinguished delegates, Ladies and Gentlemen*

It is honour and pleasure for me to address the "Workshop on Monitoring Technologies for Industrial Pollution in the Mediterranean Coastal Areas" in Türkey.

On behalf ICS project leader and on behalf of the Prof.Dr. Enrico Feoli Earth, Environmental and Marine Science and Technologies..

As well as on my own behalf to express our deepest gratitude and appreciation of the Program Officer Eng. Gennaro Longo.

I also take this opportunity to salute you and all the distinguished delegates attending the workshop on behalf of the Elisa Sorti de Roa, ICS Secretary .

1.What is Environment Pollution ?

As long as 1832 Goethe said in his Faust II:

"Everything spring from water, Everything comes from water,

Water is the force of our life"

Pollution of marine environment means the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effect as harm to living recourses and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.

Environmental pollution continues to be one of the most important problems which humanity is going today .

Although developed countries are taking serious actions for the prevention of pollution within their own national boundaries, they don't show the same sensivity in relation to economically developing countries.

As it is well known the proper environmental management in economically developing countries is hindered by factor like rapid growth in population, increase in the quantity of waste produced, scarcity of funds, lack of legislation and appropriate control mechanism, lack of knowledge, lack of co-ordination, wrong guidance by foreign companies, etc. (Curi, 1987).

Beyond these, between one main reason for the deterioration of the environment in the developing countries is the environmental exploitation practised against them by the developed world.

Coastal seas are the most heavily used and at the same time the most productive parts of the ocean.

The sustainable use of entire regions, in particular shelves seas, in the next century for large-scale cultivation of food organisms requires a detailed knowledge of the ecosystem in order not destabilize the basis for enhanced harvesting from the sea.

2. Mediterranean Coast of Turkey

The Mediterranean coast of Turkey is bordered by the Mediterranean and Aegean seas.

From the Greek border to Dalaman river is the Aegean sea and the length of the coast is 2805 kilometers. Beginning from the Dalaman river extending to the Syrian border is the Mediterranean sea with a total length of the coast 1577 kilometers.

The island in the Aegean Sea have a coastline totaling 535 kilometers and the total surface area of 420 square kilometers while those in the Mediterranean have 130 and 18 km^2 respectively.

Through the text "Mediterranean" will refer to coast of both seas, the total length of which is 4382 km and the total length of island coastline is 665 km.

3.Geographic Regions

Geographically Turkey is devided into 7 regions and the Mediterranean coast cover 3 of them,

- The Marmara,
- Aegean,
- Mediterranean

However, since the boundaries of these regions do not coincide with the provincial boundaries only their names have been utilized in the determination of coastal planning zones.

The Mediterranean represents for the European an are of interest and of major concern. Europe and the Mediterranean are connected by geography.

The Mediterranean represents for the European an are of interest and of major concern. Europe and the Mediterranean are connected by geography.

In a big coastal cities like Izmir as well as ports, marinas for pleasure and fishing crafts and the heavy Industry have been a major risks of oil spill and pollution of Izmir bay and around of the bay.

In order to carried out in connection with marine pollution generated by urban, waste and the other pollutants we must look some statistical population scenario in the Mediterranean shoreline.

Table.3.1. The urban population in Mediterranean river-basin (1950-1980)

Zone	Urban Population (%)			Population (million)			Multiplier		
Mediterranean countries	1950	1965	1980	1950	1965	1980	1950	1965	1980
Total	42.9	50.9	91	91	135	189	1	1.48	2.08
Zone A	49.8	58.9	66.1	70	95	119	1	1.36	1.7
Zone B	29.6	37.4	44.4	19	36	63	1	1.89	3.32
Zone C	35.0	56.1	67.8	2	4	7	1	2	3.5

Source:UNIDO. Zone A: Spain, France, Italy, Yugoslavia, Greece; Zone B: Turkey, Egypt Lebanon, Tunisia, Algeria; Zone C: Malta, Cyprus, Libya, Israel, Morocco

At the south and East countries (Zone B) population was 20 million in 1950, this is 30 % percent of urban population of hole Mediterranean. But this population has reached to 75 million with increasing 275 % percent in 1985.

The urban population of south and east Mediterranean countries has increased very rapidly in terms 1950-1985. This portion is equal to 2.4 times of the whole urban populations.

The increasing of the populations is being in east and south zone caused by as below the condition's.

1. The change of the high standardization, the people looking for housing, new land, vegetation and transportation.
2. The site exhaust is increasing with the living standards that is why the marginal site exhaust tendency is increasing with the incomes.

As its known Mediterranean countries and the European Union represents for the Mediterranean countries, the first economic partner.

Today, both Regions are economically very depended. The Mediterranean Partners export 46 % of their production to the European Union and 36 % of their imports originate from the Union.

Without taking into account the intra-Eurepean trade, the Mediterranean Partners constitute 8.5 % of the export and 6.5 % of the imports of the Union.

From the point of wives of science and technology an important potential also exist. In the subject areas corresponding to the problems which they face (energy, environment, ect), the scientist of the Mediterranean countries could quickly develop world level expertise assuming that adequate support is available.

On the other hand, in areas such as information technology and telecommunication the Mediterranean countries could benefit from the effect of a " technological jump", like the Asian countries by mobilizing the most advanced technologies.

The process of littoralization is even more activities on the coast, particularly in industrial development and the other branches of economy. The locating of industry on the coastline, dictated by the law of economy, is a very prominent feature in the Mediterranean region.

Iron works, oil refineries, petrochemical plants, all are industries taking advantage of sea transportation, while also, bringing along a whole series of other economic activities.

Constructions of ports and port complexes consuming large portion of land followed the construction of these industries.

Traffic corridors very often go along the coastline, thus contributing to even higher concentration of activities.

The high concentration of activity, easy fuel supply and abundance of cooling water for installations, have encouraged power plant construction of high capacity in the proximity of the sea.

Introduced in the European Council of Lisbon 1992, developed further during the Councils of Corfu and Essen in 1994, then of Cannes in 1995, the idea of a "Euro-Mediterranean Partnership" took shape with the Euro-Mediterranean Barcelona Conference in November 1995 which included into its work program for the Euro-Mediterranean partnership a clear reference to the importance of RTD corporation in tackling the problem of widening gap of scientific achievement;

4.The Organic Load of Domestic Sewage

In Turkey, rural settlement's are not served by public sewer system, and domestic wastes from rural areas are not so important as the wastes from urban areas.

In urban areas, the number settlement centres having a technically suitable system and a treatment plant is quite low.

The construction of sewer system without a treatment plants plays an important role in the increase pollution load in receiving water bodies.

Detergents are a major constituent of domestic pollution. However, in the production of detergents, LAB has been started to be used instead of biologically non-degradable ABS.

The organic load of domestic sewage discharged directly into the Mediterranean or through rivers is listed as a rough estimation in table 5.1.

Table 4.1.Organic load of domestic sewage (t/year, approx.1970)

State	BOD[1]	Phosphorus	BOD per km coastline	Phosphorus coastline
Spain	130.000	5.900	60	2.7
France	360.000	16.000	336	15.0
Italy	400.000	18.000	61	2.7
Yugoslavia	17.000	800	27	1.2
Malta	8.000	320	67	2.7
Greece	100.00	4.500	37	1.7
Turkey	100.000	4.500	36	1.6
Lebanon	31.000	1.250	149	6.0
Israel	32.000	1.400	145	6.5

Table.4.2: Chemical load from Turkey into the Mediterranean (tons/year).

Product	Load(tons/year)
Mineral Oil	4000
Phenol	900
Tensile	6000
Phosphate	20000
Nitrogen Compound	90000
Mercury	10
Lead	400
Chromium	250
Pesticide	7

5.Industrial Pollution

In Turkey, industrial wastes are one of the most important factors in water pollution. The establishment of industries in certain localities, which are close to raw material and marketing facilities and especially to water resources, causes pollution to be intensified.

In addition to this localisation of industries, mineral exploitation and ore enrichment processes threaten water and soil resources. Most of the Turkish industries are not have waste treatment facilities and those that have are often insufficient or not operated properly.

There is no general inventory of industrial pollution in Turkey. However during the study of pollution situations of certain water recourses, the industries discharging their wastes into this resource are being studied.

In the last years a considerable amount of new factories, has been established by froing capital in the developing countries. The most of them of these plants are industries like chemicals, cement etc. Famous with the hazardous wastes which they produce or the high risk for industrial accidents, which they have.

According to the UN Centre or Transitional Corporations (1985) approximately 25 % of the stock of foreign direct investments in manufacturing in developing countries realised in 1983 by USA, UK, Japan and Germany was for chemicals.

On the other hand, 38% of stock of US investment in developing countries realised in 1983, 29% of Japanese in 1983, 21% of total German in 1981-1983 were for agriculture, mining and the other extractive industries.

These figures are clear indication that majority of investments is either for dirty industries or for exploitation of natural resources.

Foreign investors, taking usually advantage of the ignorance of local authorities or the lack of proper legislation of the environment and thus maximising their profit.

It is well known that developing countries in order to realise different projects they usually need grads and credits originating from the international organisations.

It is unfortunate to say that least in the environmental field, these grand's and credits bring with them conditions which many times can hardly considered as beneficial for the developing countries.

Co-ordinated Regional Action for the Reduction of Industrial Pollution in the Framework of the Mediterranean Action Plan

Mr. G. Kamizoulis, MAP, Athens

Industrial Development

- Proposed Targets
- Proposed Activities at the Regional Level

TPBs

- ♦ POPs

Twelve Priority POPs

Polycyclic Aromatic Hydrocarbons (PAHs)

- ♦ HEAVY METALS (Hg, Cd, Pb) and ORGANO-METALLIC COMPOUNDS

Heavy Metals

Organometallic Compounds

OTHER HEAVY METALS

ORGANOHALOGEN COMPOUNDS

- ♦ Halogenated Aliphatic Hydrocarbons
- ♦ Halogenated Aromatic Hydrocarbons
- ♦ Chlorinated Phenolic Compounds
- ♦ Organohalogenated Pesticides

RADIOACTIVE SUBSTANCES

NUTRIENTS AND SUSPENDED SOLIDS

- ♦ Industrial Wastewater

- Nutrient Loads from Agriculture

HAZARDOUS WASTES

- Obsolete Chemicals
- Used Lubricating Oil
- Used Batteries

Targets for the Reduction of Industrial Pollution

- Point sources discharges and air emissions by 2025 to be in conformity with all existing provisions
- Reduction of 50% of TPB discharges, emissions and losses over a period of 10 years
- Reduction of 50% of polluting substances discharges, emissions and losses over a period of 10 years in hot spots and areas of concern

TARGETS

Twelve Priority POPs

- *By the year 1010 to phase out inputs of the 9 pesticides and PCBs and reduce to the fullest possible extent inputs of unwanted contaminants: hexachlorobenzene, dioxins and furans*
- *By the year 2005, to reduce 50% inputs of the priority 12 POPs*
- *By the year 2005 to collect and dispose all PCB waste in a safe and environmentally sound manner*

Polycyclic Aromatic Hydrocarbons

- *By the year 2025, to phase out to the fullest possible extent inputs of PAHs*
- *By the year 2010, to reduce by 25% inputs of PAHs*

Heavy Metals

- *By the year 2025, to phase out to the fullest possible extent discharges and emissions and losses of heavy metals (mercury, cadmium and lead)*
- *By the year 2005, to reduce by 50% discharges, emissions and losses of heavy metals (mercury, cadmium and lead)*
- *By the year 2000, to reduce by 25% discharges, emissions and losses of heavy metals (mercury, cadmium and lead)*

Radioactive Substances

- *To eliminate to the fullest possible extent inputs of radioactive substances*

Industrial Wastewater

- *By the year 2025, to dispose all waste water from industrial installations which are sources of BOD, nutrients and suspended solids, in conformity with the provisions of the LBS Protocol*

- *Over a period of 10 years, to reduce by 50% inputs of BOD, nutrients and suspended solids from industrial installations sources of these substances*

Nutrients from Agriculture

- *To reduce nutrient inputs from agriculture and aquaculture practices into areas where these inputs are likely to cause pollution*

Hazardous Wastes

- *By the year 2025, to dispose all hazardous wastes in a safe and environmentally sound manner and in conformity with the provisions of the LBS Protocol and other international agreed provisions*

- *Over a period of 10 years, to reduce as far as possible by 20% the generation of hazardous waste from industrial installations*

- *By the year 2010, to dispose 50% of the hazardous waste generated in a safe and environmentally sound manner and in conformity with the provisions of the LBS Protocol and other internationally agreed provisions*

Obsolete Chemicals

- *By the year 2005, to collect and dispose all obsolete chemicals in a safe and environmentally sound manner*

Used Lubricating Oil

- *By the year 2005, to collect and dispose 50% of used lubricating oil in a safe and environmentally sound manner*

Used Batteries

- *By the year 2025, to dispose all used batteries in a safe and environmentally sound manner and in conformity with the provisions of the Protocol and other inter-nationally agreed provisions*

- *Over a period of 10 years, to reduce by 20% the generation of used batteries*

- *By the year 2010, to dispose 50% of used batteries in a safe and environmentally sound manner and in confor-mity with the provisions of the Protocol and other agreed international provisions*

Activities at Regional Level for the Reduction of Industrial Pollution

- By the year 2005, to formulate and adopt **guide-lines** for industrial wastewater **treatment** and **disposal**
- By the year 2010, to formulate and adopt, as appropriate, **environmental quality criteria and objectives, and emission limit values** for point source discharges into water or air
- To develop **programmes** for sharing and exchanging technical information and advice regarding **environmentally sound wastewater treatment and facilities,** including the use of treated waste water, sludge and waste
- To promote **research programmes** to identify and validate **wastewater treatment technologies**
- To prepare **guidelines** for the application of **BAT, BEP** and **clean technology** for industries
- To support the development and application of the **Environmental Management and Audit Scheme** (EMAS and ISO 14000)

Activities at Regional Level for the Reduction of the Twelve Priority POPs

- To provide Contracting Parties with technical information and advice on the nine pesticides and PCB substitutes and make appropriate recommendations
- To develop programmes for sharing and exchanging technical information and advice regarding the environmentally sound disposal of the existing quantities of the nine pesticides and PCBs. These programmes should consider their progressive elimination, including the decontamination of equipment and containers
- To prepare guidelines for the application of BEP and if possible BAT by the point sources of dioxins and furans

Heavy Metals, Polycyclic Aromatic Hydrocarbons, and Organometallic Compounds, and Organohalogen Compounds, and Other Heavy Metals

- To prepare guidelines for the application of BAT and BEP in industrial installations which are sources of the above mentioned
- By the year 2010, to formulate and adopt, as appropriate, environmental quality criteria and standards for point source discharges and emissions of the above mentioned

Activities at Regional Level for the Reduction of: Radioactive Substances

- To transmit to the Parties reports and other information received in accordance with the Convention and the Protocol

Industrial Wastewater

- To prepare guidelines for the application of BAT and BEP in industrial installations which are sources of BOD, nutrients and suspended solids

- By the year 2010, to formulate and adopt, as appropriate, environmental quality criteria and standards for point source discharges of BOD, nutrients and suspended solids
- By the year 2010, to formulate and adopt guidelines for waste water treatment and waste disposal from industries which are sources of BOD, nutrients and suspended solids

Used Lubricating Oil

- To formulate and adopt a standard on the maximum amount of PCB an oil may contain before it is considered to be contaminated (i.e. 50 mg/k)

Activities at Regional Level for the Reduction of Nutrient loads from Agriculture

- To participate in the programme and activities of inter-national organizations, especially FAO, on sustainable agricultural and rural development in the Mediterranean
- To participate in the FAO programme on the sustainable use of fertilizers and to encourage the preparation of national and regional strategies based on the controlled, appropriate and rational use of seeds, fertilizers and pesticides
- To prepare guidelines for the application of BEP (including good agricultural practices) for the rational use of fertilizers and the reduction of losses of nutrients from agriculture

Hazardous Wastes

- To prepare a Mediterranean Strategy for the Management of Hazardous Wastes. This strategy will be based on the principles of prevention, reduction and reuse, and the application of Best Available Techniques and Best Environmental Practices for disposal; the regulation of transport and the remedial actions will be taken into account
- To formulate and adopt common anti-pollution measures for hazardous wastes

Obsolete Chemicals

- To develop programmes for sharing and exchanging technical information and advice regarding the environmentally sound disposal of obsolete chemicals. These programmes should consider their progressive elimination, including the decontamination of equipment and containers

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Industrial Ecology and Bioremediation: Theoretical Framework and Technological Tools for Sustainable Development.

Mr. E. Feoli, Scientific Coordinator - Earth, Environmental and Marine Sciences and Technologies, ICS/UNIDO, Trieste

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Abstract

It is discussed:

- The concept of industrial ecosystem af different hierarchical levels.
- The concept of ecological industrial carrying capacity and
- The concept of minimal area.

It is suggested:

- That bioremediation is a technological tool very important for industrial ecology

It is stressed:

- The importance of vegetation system for the sustainability of industrial ecosystems.
- The need for integrated technological tools of decision domain with the technological tools of production system.

Decision domain:

The targeted decision domain relates to the design and implementation of policy and regulatory mechanisms addressing the following, partly overlapping, topics

Regional development: This includes spatial and structural industrial development planning and its typical activities such as

- siting, environmental impact assessment
- zoning, environmental quality objectives
- industrial structure planning (sectoral composition)
- infrastructure planing
- cross-sectoral coordination

Pollution prevention: This focuses on incentives and regulations at the enterprise level to promote

- technology innovation
- cleaner production (source reduction, waste minimization)

- pollution control and waste treatment (end-of-pipe/stack)

Industrial risk: This relates to the control and management of

- toxic and hazardous substances and wastes (pollution release and transfer registers)
- chemical safety, loss prevention
- risk assessment, contingency and emergency planning

These initial topics are not ment to be exhaustive or exclusive, and will need to be amended as new problems emerge and experience is gained.

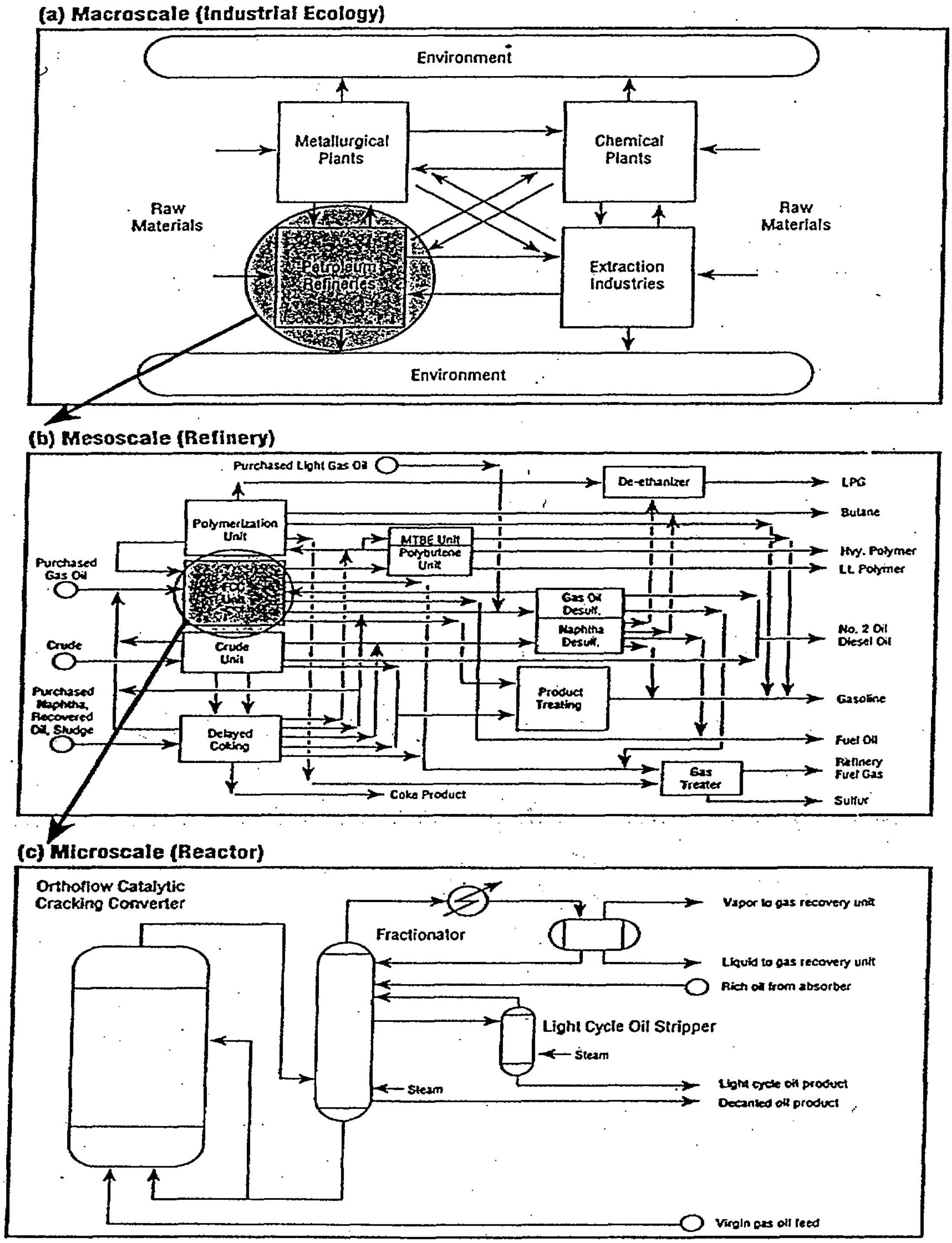


FIGURE 1: The flow and transformation of chemical substances in industry is a key feature in waste minimization or pollution prevention. Analysis of such flows can be conducted at (a) the macroscale (industrial metabolism or industrial ecology), (b) the mesoscale or individual manufacturing plant (e.g., refinery), or (c) the individual chemical reactor. Scales (b) and (c) correspond to chemical process engineering.

Table 1.2: Typical Potentially Hazardous Waste Streams from Various Industrial Sectors

Sector/Source	Typical Hazardous Waste Stream
Agricultural and Food Production	Acids and Alkalis; Fertilizers (e.g., nitrates); Herbicides (e.g., dioxins); Insecticides; Unused pesticides (e.g., aldicarb, aldrin, DDT, dieldrin, parathion, toxaphene)
Airports	Hydraulic fluids; Oils
Auto/Vehicle Servicing	Acids and Alkalis; Heavy metals; Lead-acid batteries (e.g., cadmium, lead, nickel); Solvents; Waste oils
Chemical/Pharmaceutical Industry	Acids and Alkalis; Biocide wastes; Cyanide wastes; Heavy metals (e.g., arsenic, mercury); Infectious and Laboratory wastes; Organic residues; PCBs; Solvents
Domestic	Acids and Alkalis; Dry-cell batteries (e.g., cadmium, mercury, zinc); Heavy metals; Insecticides; Solvents (e.g., ethanol, kerosene)
Dry Cleaning/Laundries	Detergents (e.g., boron, phosphates); Dry cleaning filtration residues; Halogenated solvents
Educational/Research Institutions	Acids and Alkalis; Ignitable wastes; Reactives (e.g., chromic acid, cyanides; hypochlorites, organic peroxides, perchlorates, sulfides); Solvents
Electrical Transformers	Polychlorinated biphenyls (PCBs)
Equipment Repair	Acids and Alkalis; Ignitable wastes; Solvents
Leather Tanning	Inorganics (e.g., chromium, lead); Solvents
Machinery Manufacturing	Acids and Alkalis; Cyanide wastes; Heavy metals (e.g., cadmium, lead); Oils; Solvents
Medical/Health Services	Laboratory wastes; Pathogenic/Infectious wastes; Radionuclides; Solvents
Metal Treating/Manufacture	Acids and Alkalis; Cyanide wastes; Heavy metals (e.g., antimony, arsenic, cadmium, cobalt); Ignitable wastes; Reactives; Solvents (e.g., toluene, xylenes)
Military Training Grounds	Heavy metals
Mineral Processing/Extraction	High-volume/Low-hazard wastes (e.g., mine tailings); Red muds
Motor Freight/Railroad Terminals	Acids and Alkalis; Heavy metals; Ignitable wastes (e.g., acetone; benzene; methanol); Lead-acid batteries; Solvents
Paint Manufacture	Heavy metals (e.g., antimony, cadmium, chromium); PCBs; Solvents; Toxic pigments (e.g., chromium oxide)
Paper Manufacture/Printing	Acids and Alkalis; Dyes; Heavy metals (e.g., chromium, lead); Inks; Paints and Resins; Solvents
Petrochemical Industry/Fueling Stations	Benzo-*a*-pyrene (BaP); Hydrocarbons; Oily wastes; Lead; Phenols; Spent catalysts
Photofinishing/Photographic Industry	Acids; Silver; Solvents
Plastic Materials and Synthetics	Heavy metals (e.g., antimony, cadmium, copper, mercury); Organic solvents
Shipyards and Repair Shops	Heavy metals (e.g., arsenic, mercury, tin); Solvents
Textile Processing	Dyestuff; Heavy metals and compounds (e.g., antimony, arsenic, cadmium, chromium, mercury, lead, nickel); Halogenated solvents; Mineral acids; PCBs
Timber/Wood Preserving Industry	Heavy metals (e.g., arsenic); Non-halogenated solvents; Oily wastes; Preserving agents (e.g., creosote, chromated copper arsenate, pentachlorophenol)

Table: Perceived Major Problems and their Root Causes*

MAJOR TYPES OF PROBLEMS	TRANSBOUNDARY ELEMENTS OF MAJOR TYPES OF PROBLEMS	MAIN ROOT CAUSES**	TYPES OF ACTION**
DEGRADATION OF COASTAL AND MARINE ECOSYSTEMS	~ Damage to transboundary ecosystems, including loss in productivity, biodiversity and stability ~ Reduction of regional values ~ Decreased quality of life ~ Degradation due to pollution and eutrophication ~ Region-wide loss of revenue	MANAGEMENT FINANCIAL LEGAL HUMAN STAKEHOLDERS	PLANNING RESOURCES
UNSUSTAINABLE EXPLOITATION OF COASTAL AND MARINE RESOURCES	~ Impacts on habitats and biodiversity ~ Impacts of physical changes on coastal and beach dynamics ~ Loss of existing and potential income from fishing and tourism ~ Conflicts between user groups	MANAGEMENT FINANCIAL STAKEHOLDERS HUMAN LEGAL	RESOURCES PLANNING
LOSS OF HABITATS SUPPORTING LIVING RESOURCES	~ Damage to migratory species and their habitat ~ Endangered biotic resources ~ Loss of values for development ~ Habitat and food web changes	MANAGEMENT FINANCIAL STAKEHOLDERS HUMAN LEGAL	RESOURCES PLANNING
DECLINE IN BIODIVERSITY, LOSS OF ENDANGERED SPECIES AND INTRODUCTION OF NON-INDIGENOUS SPECIES	~ Loss of Regional values ~ Damage to endangered and endemic species of regional and global significance ~ Loss of genetic biodiversity	MANAGEMENT FINANCIAL LEGAL HUMAN STAKEHOLDERS	PLANNING RESOURCES
INADEQUATE PROTECTION OF COASTAL ZONE AND MARINE ENVIRONMENT AND INCREASED HAZARDS AND RISKS	~ Reduction of regional values ~ Loss of revenues ~ High costs of curative interventions ~ Decreased quality of life	MANAGEMENT FINANCIAL LEGAL HUMAN STAKEHOLDERS	PLANNING RESOURCES
WORSENED HUMAN RELATED CONDITIONS	~ Human health impact ~ Costs of dealing with human migration ~ Reduced human and institutional capacity ~ Reduction of development potential ~ Increased poverty with transboundary impacts	MANAGEMENT FINANCIAL LEGAL HUMAN STAKEHOLDERS	PLANNING RESOURCES
INADEQUATE IMPLEMENTATION OF EXISTING REGIONAL AND NATIONAL LEGISLATION	~ Ineffective protection of the marine and coastal environment ~ Inadequate monitoring of pollution and consequently inadequate data interpretation for managerial purposes ~ Poor public education and awareness regarding scientific and economic values and technical options	LEGAL MANAGEMENT FINANCIAL HUMAN STAKEHOLDERS	PLANNING RESOURCES

* The analysis in this table does not necessarily apply to all contracting Parties to the Barcelona Convention.

** Main root causes and types of action are indicated in the descending order of significance.

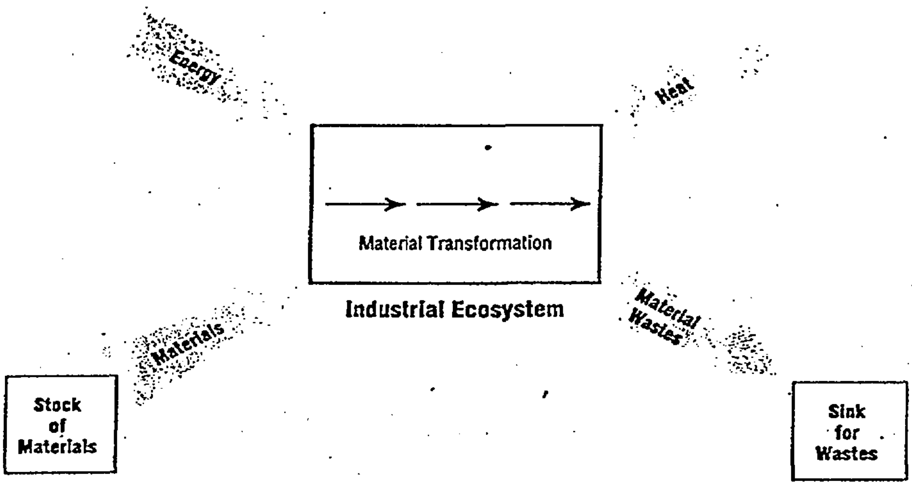


FIGURE 1 Type I industrial ecosystem.

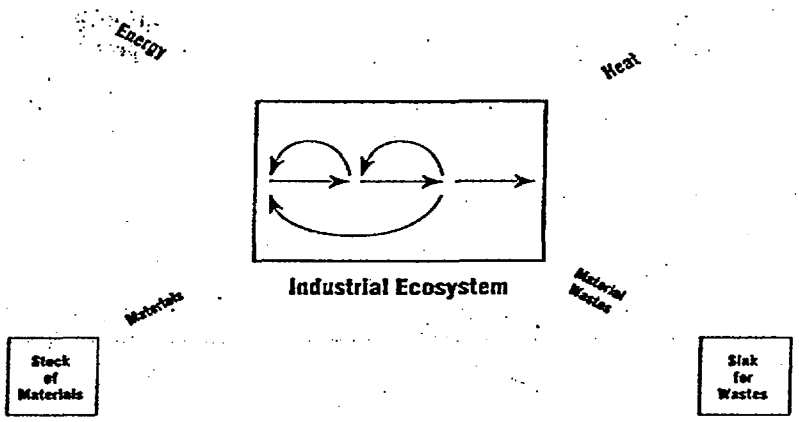


FIGURE 2 Type II industrial ecosystem.

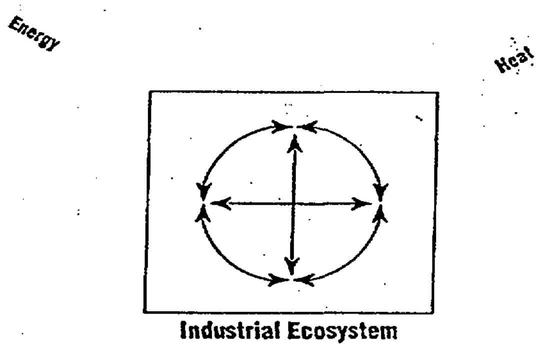
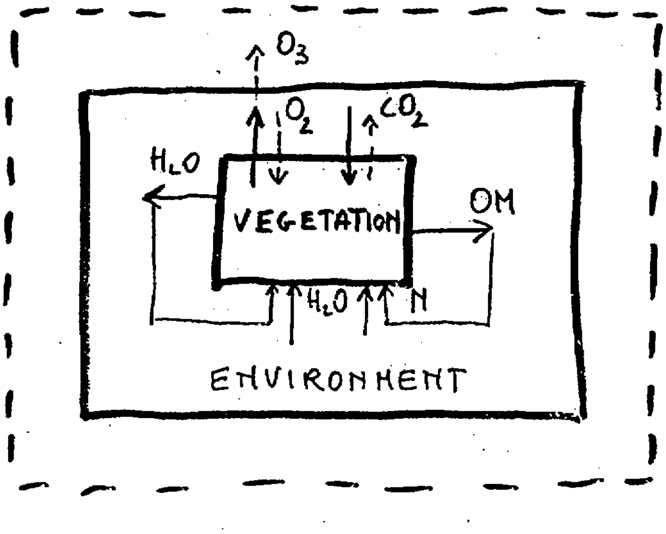


FIGURE 3 Type III industrial ecosystem.



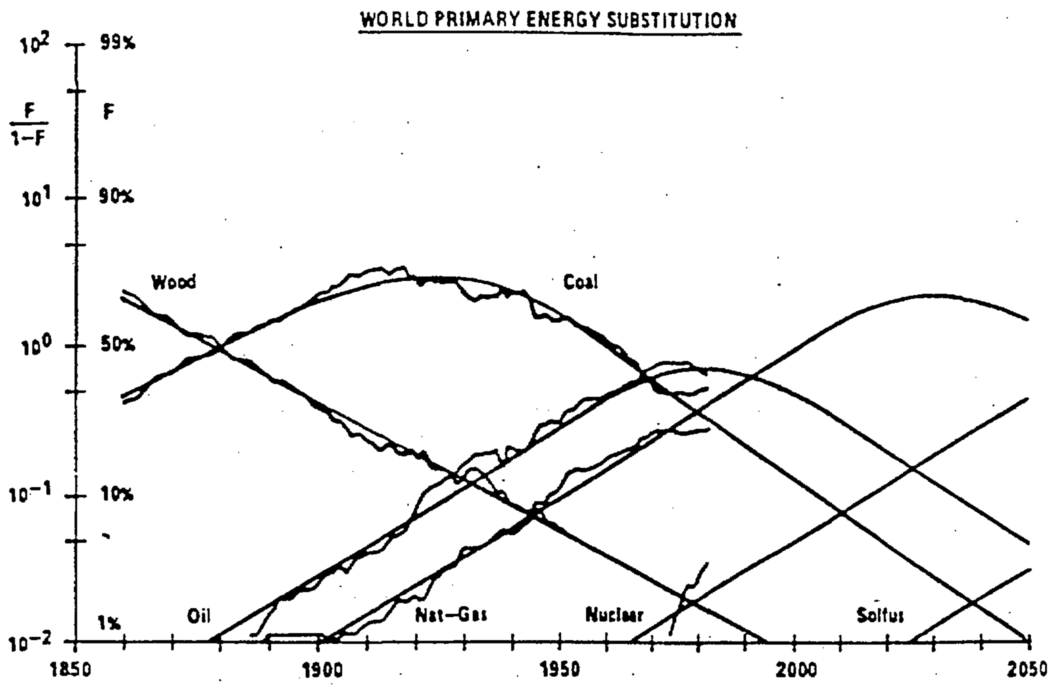


FIGURE 4. The idea that primary energies compete for the energy market like the varieties of a species for the resources of a niche, give a conceptual framework and a mathematics to deal with the evolution of the energy markets. The excellent fitting of the equations (smooth lines) with the statistical data for more than one hundred years give much weight to their use for forecasting. The fast rise of nuclear by respect to a business as usual market penetration equation is probably due to the fact that nuclear sells wholesale and has not the necessity of laying its own distribution grid. A similar phenomenon did occur when natural gas started diffusing in countries, where city gas distribution nets existed already (Marchetti and Nakicenovic, 1979).

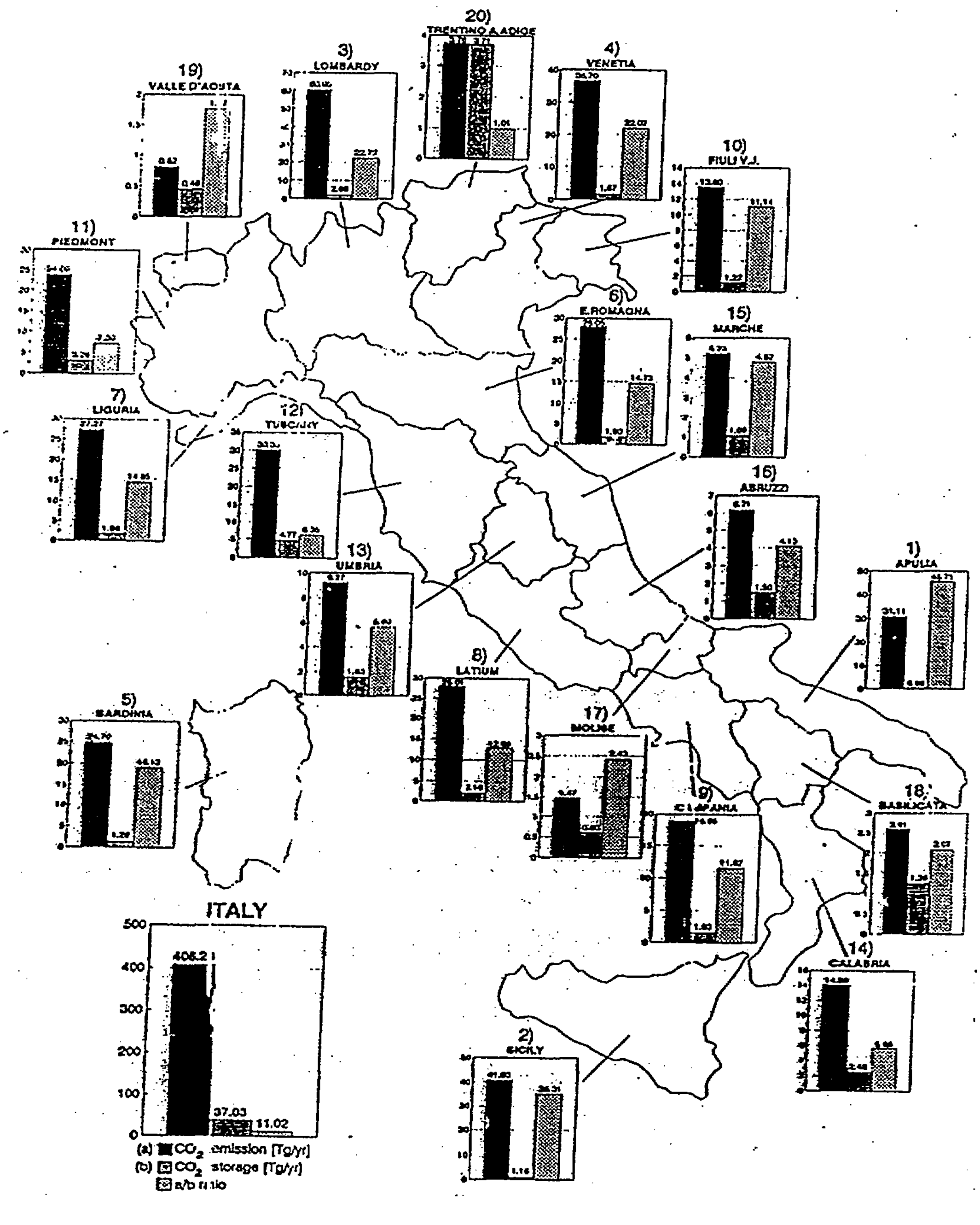


Fig. 2 – CO_2 emission by human activity (a) and stored in the cumulated biomass of the ordinary forests with productive stand (b) for 1985. The figure above the region name permits an ordering against the ratio (a)/(b).

Introduction

White (1994) has defined industrial Ecology (IE) as the study of:

- the flows of materials and energy in industrial and consumer activities
- the effects of these flows on the environment, and
- the influences of economic, political, regulatory, and social factors on the flow, use and transformation of resources.

The objective of industrial ecology is to understand better how we can integrate environmental concerns into our economic activities.

According to Gradel (1994)

"IE seeks to optimize the total industrial materials cycle from virgin material to finished product to ultimate disposal of wastes".

According to Frosch (1992)

"IE is based upon a straightforward analogy with natural ecological systems"... "The system structure of a natural ecology and the structure of an industrial system, or an economic system, are extremely similar".

IE offers a clear framework of interactions, namely the interactions between industry, economy and the basic environmental variables of the environmental systems.

IE deals with a multidimensional space in which all kinds of ecosystems are developing their trajectories.

This is an ecological space (Feoli and Orloci 1991) that includes the space defined by Tewolde Egziabher (1982) as technological space.

IE is analyzing the environment within the industrial plants and outside the industrial plants by using a system approach.

According to Richards et Al. (1994) IE *"can help illuminate useful directions in which the system might be changed".*

As the mature natural ecosystems the industrial systems should develop in such a way to minimize the sink of waste.

For this man has to find technological solutions for using the wastes as resources and /or to change the technology as to minimize the energy and material consumption, i.e. by developing the so-called clean technology (Ehrenfeld 199þ).

IE forces to see the biosphere under the perspective suggested by Vernadsky (1945), namely, as the "noosphere".

The noosphere is the result of the interactions between the biosphere and the human activities.

These are all based on the human culture and man ability to apply scientific and technological knowledge.

We can say that the problem of sustainable development, i.e. the development that does not deplete the resources of the future generations, is to find solutions for the sustainability of the noosphere.

The sustainable development can be seen only under a global perspective. At present, all the industrial plants that are placed in different states for different historical, political, economical and environmental reasons (resource availability) give the overall industrial system of the noosphere.

An industrial plant is sustainable only if row material, energy, water, labour, information and market are available. The availability of these items is outside the industrial plant and in many cases also outside the state in which it is located.

It is not possible to see the industrial system isolated from the environment and the other human systems (socio-economic system, transportation system, agricultural system, etc.) and/or confined within the administrative-political boundaries in which if is placed.

All the industrial plants have strict links not only with the areas from where raw material, energy, water, labour, information are coming and where the products are going, but also with the areas from where oxygen and water are coming and with the areas where pollutants are going by air and water.

It is obvious that the concept of industrial system if viewed under the ecological perspective leads to the concept of industrial ecosystem, therefore we can say that IE is the study of industrial ecosystems.

Why to put together industrial ecology and bioremediation?

The industrial ecosystem is sustained as all the other ecosystems in the noosphere by the biotic components.

Of these the most visible is vegetation, natural and artificial (crops), the less visible is the microbial component.

Vegetation:

- builds up organic matter
- produces oxygen, many kind of chemicals and materials
- creates special structured environments for the animals
- protects the soil and
- regulates or interferes with all the bio-geo-chemical cycles of the biosphere.

Microbes:

- decompose the organic matter by different type of respiration (aerobic, anaerobic, fermentation, etc.) including organic contaminants and/or
- produce precipitation and immobilization of metals.

IE and industrial ecosystems under the perspective of sustainable development

Tibbs (1992, cited in Ehrenfeld 1995)) presented seven practical objectives of IE, these are:

1) Improving the metabolic pathways of industrial processes and material use
2) Creating loop-closing industrial ecosystems
3) Dematerializing industrial output

4) Systematizing patterns of energy use
5) Balancing industrial input and output to natural ecosystem capacity
6) Aligning policy to conform to long-term industrial system evolution
7) Creating new action coordinating structures, communicative linkages, and information.

Ehrenfeld (1995) considers the Tibbs's practical framework a convenient way to organize a complex set of notions into two categories, one containing the technological elements including objectives 1) to 4) and the other including the organizational and strategic elements including the objectives 5) to 7). Ehrenfeld focuses his discussion on IE under the perspectives of developing a product policy and suggests guidelines to develop such a policy accordingly.

Folke (1992) has an approach consistent with IE. He cites a statement of Ulanowicz (1989) written in the review of the Odum's book (1989)

"Despite all the advances in modern technology, society remains irrevocably dependent upon natural systems for life-support a condition that is unlikely to change in the foreseeable future".

The definition of industrial ecosystems must be based on structures and functions of the industrial systems.

An industrial system may be defined at the level of:

- a single factory
- a set of factories of the same typology (i.e. food factories, or refineries, etc.)
- a set of different factories that are sited in specific industrial settlements (industrial areas, industrial parks, etc.)
- sets of industrial settlements belonging to small administrative units (e.g. municipality) or to administrative units of higher level such as the province or the state.

An industrial system may be defined also at the level of set of states, provided interconnections and links are present between the components (e.g. the industrial system of the European Union).

Since the concept of self-sustainability is implicit in the concept of industrial ecosystem the definition of any industrial ecosystem is not complete if we do not define the area (portion of the biosphere) sustaining the industrial system under all the ecological point of views. This is analogous to the concept of minimal area in ecology, i.e. the area necessary to support one ecosystem.

The industrial ecosystem is given by the industrial plant(s), by the necessary infrastructures, by the land occupied by them and by

- an area containing the ecosystems necessary for the self-sustainability of the industrial ecosystem
- irrespective where this area is placed and what is its shape.

The questions that we have to answer are:

- How much air and water are consumed by the industrial systems?

- From where air and water are coming?
- Is the "metabolism" of the industrial systems reducing directly or indirectly the biodiversity?

If yes is the reduction undermining the selfsustainability of biodiversity?

Carbon Dioxide Convention, following the UNCED of 1992.

"1) An agreement specifying specific emission reduction targets for all the participants (the command-and-control approach); 2) an international uniform carbon tax scheme with the redistribution of the receipts (the international uniform carbon fax approach) and 3) a less ambitious instrument of harmonized national carbon taxes (the minimal carbon tax approach)"

Industrial systems, industrial ecosystems and ecological industrial carrying capacity

What it is necessary for the definition of an industrial system is to define its components and the type of connections between them.

The components of the system are given by:

- the production plant(s),
- the system of row material sources (other plants or mines),
- the energy system,
- the transportation system (roads, railways, airports, ports, etc. and cars, trucks, ships, etc.) used for energy, man power, row materials, products and waste transfer
- the financial system used for financial support,
- the market system,
- the urban system hosting the man power,
- the information system (institutions, firms, RBzD centers etc.) from where the information for technology and marketing is coming,
- the communication system used for information transfer, and
- the waste treatment system.

The connections that justify the existence and definition of the industrial systems are:

- spatial connections, i.e. the distance between the components and the communication pattern between them,
- energetic connections, i.e. between the components,
- the pattern of energy flows
- material connections, i.e. the pattern of material flows between the components,
- economic connections, i.e the pattern of financial flows,
- information connections, i.e. the pattern of information flows.

multiplicity of the system = the number of different components connectance = the number of connections between the components

Grubler (1994) conceptualizes the industrialization as a historical phenomenon as:

"a succession of phases, characterized by the pervasive adoption of technology clusters".

The cluster is defined as

'a set o interrelated) technological, organizational and institutional innovations driving industrial output and productivity growth".

The analogy with the ecological succession is very strict and it is more strictly envisable in the following Grubler's statements: '

"Such a succession is, however not a rigid temporal sequence as various clusters coexist (with changing weights) at any given time. Older technological and infrastructural combinations coexist with the dominant technology cluster, and in some cases previous clusters (compared to the dominant technology base in the leading industrialized countries) are perpetuated, as was largely the case in the post-World War II industrial policy of the former USSR".

The technology clusters are analogous to the species clusters (species associations) in ecology.

In analogy of what happens in ecology, trajectories can be described in the multidimensional space defined by the variables describing the components and the connectance of industrial ecosystems.

It has to be clear that an industrial ecosystem does root include all the other systems with which it is interacting (transportation system,' urban system, agricultural system, socio-economic system, financial system, etc.). Each industrial system has a type of connectance with other systems and with the environmental system depending on its "technological typology".

Life-Cycle Assessment and Eco-efficiency

The life cycle (LC) is a concept developed by IE that refers to the history of products and all the parts of the industrial system (that are also products of the same or other industrial systems) and the system itself, from their "born" to their "death".

In each stage of ifs life (raw material collection, manufacturing, primary use, secondary use, ... , disposal) a product has a more or less intense and direct or indirect impact on the environment since it occupies space and/or consumes the environmental resources.

The reason to study the LC is to get information on how to produce a product by a process design that minimizes the overall environmental impact of the industrial system. Its is therefore necessary to integrate the Life-Cycle Assessment (LCA) with the industrial Design For the Environment (DFE). This will lead to the development of the so-called clean technology application to industrial production processes.

There are some examples of applications in Braungart (1994) with the perspective to replace as much as possible the waste management by the product lifecycle management.

How to measure the eco-efficiency of an industrial system?

The eco-efficiency can be measured by the amount of resources of any kind consumed for the sustainability of the corresponding industrial ecosystem.

The ecological efficiency of an industrial system is improving when the minimal area for its self- sustainability is decreasing. '

Reducing the minimal areas of industrial ecosystem should be the target of international and national environmental policy.

According Ehrenfeld (1994,1995) the product policy should play an important role in the implementation of industrial ecology by creating favorable framework of institutions supporting the sustainable industrial development.

A major policy challenge should be *"to discover ways to get beyond price as the only means of coordinating actions in the market. Green consumerism is claimed to be a powerful new force for bringing about changes in corporate strategies and forcing product innovation. ... Individual choice can be transformed, in a broad cultural sense, through education about the relationship of environment to our survival and through the development of increased competence in taking a more critical stance toward the way we value nature".*

The life-cycle assessment is one of the applications of IE that would help the industrial enterprises within an industrial system to conform their standards with ISO 14000 (Marcus and Willig 1997). The ISO 14000 are a set of evolving guidelines that are supposed to help the industrial systems to improve their ecological efficiency.

However other perspectives have to be introduced from IE. These need education and new research directions. '

Stahel (1994) suggests a shift to an economy that sells the functionality of products rather the products themselves to decelerate materials flow.

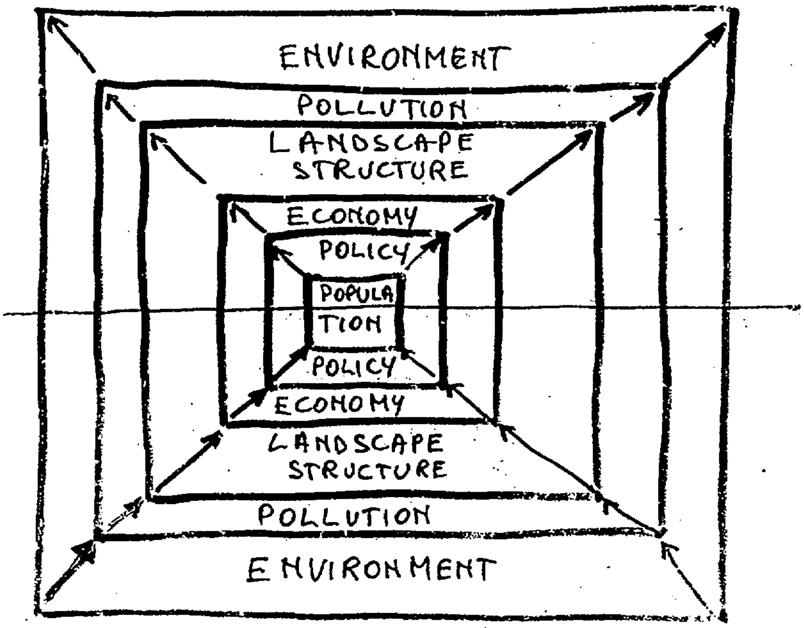
Another practice that should be used in this direction is the reuse of the product as much as possible before recycling. These suggestions require to introduce strategies into the economy that demand, a change in

"the mind-set of corporations and government. However, these strategies are themselves long term and are here to stay, once established. For strategic reasons, dynamic companies should therefore try to be the first in their field of activity to change" (Stahel 1994).

Notwithstanding ISO 14000, the 1992 UNCED conference, the 199þ Kyoto conference (etc.), the application of clean technology to the industrial system is still a slow process.

As a consequence of this slowness, today we are pressed to find solutions that are related to end-of-pipe pollution treatment, waste management and remediation, in order to reduce as much possible the negative impacts on the noosphere of all the industrial systems.

ACTION



RETROACTION
REACTION

Bioremediation

Bioremediation is a set of technological tools belonging to remediation technology.

Remediation is here considered as the set of technologies that are useful to:

- halt ecosystem degradation and
- redirect a disturbed ecosystem in a trajectory ensuring the self sustainability of the ecosystem.

Remediation includes:

- restoration *sensu stricto* (when the aim is to reconstruct the original ecosystem)
- restoration *sensu latu* (when the aim is to halt degradation and to redirect a disturbed ecosystem in a trajectory resembling that presumed to have prevailed prior to the onset of disturbance) and
- rehabilitation or reclamation (when the primary goal is to restore the ecosystem productivity for the benefit of local people irrespective the type of intervention).

Bioremediation is a practical activity that aims to use biological organisms for rehabilitation of degraded and degrading areas owing to different types of human activities.

Decontamination may be only a necessary step of remediation toward the rehabilitation. Bioremediation is the remediation of degraded areas, contaminated or not, both by microbes and by higher plants.

Bioremediation is not a panacea to be applicable in any circumstances, it can solve some problems only if applied following guidelines that are based on ecological concepts.

It is useful to distinguish between

- microbial remediation
- phyto-remediation

Tiedje (1993) considers the basic principles of ecology, namely: specificity, diversity, biogeography and natural selection. The microbial activity is related to three key questions:

1) Is the contaminant degradable?
2) Is the environmental habitable?
3) What is the rate-limiting factor and can it be modified?

The third question concerns the limiting factor identification once biodegradability and habitability have been established. Thus treatments to overcome a rate limitation can be implemented (oxygen supply, nutrient supply, adjustment of pH, dilution of toxicants, etc.)

Photo-remediation is presented under ecological perspective by ordan III et al. (1987) and Redente and Depuit (1988). Reclamation is viewed under the perspectives of successional process of vegetation first defined by Clements (1916). It consists in the following phases:

- migration,
- ecesis,
- reaction,
- competition and
- stabilization.

The following concepts of vegetation ecology are essential for phyto-remediation:

1) *Plant community* is a state of the vegetation system given by a combination of populations of different plant species living together in an area environmentally homogeneous.
2) *Species niche is* a portion of the ecological space defined by the ranges of all the factors in which the species can live.
3) *Plant association* is the vegetation type that defines the fundamental hierarchical level in the hierarchic classification of the biosphere (Mueller Dombois and Ellenberg 1974, Walter 1979). The plant communities that are considered similar enough are grouped into the same community type called plant association.
4) *Community niche.* is the portion of ecological space occupied by a plant association.
5) *Ecological succession* is the unidirectional sequence of plant associations corresponding to different states of vegetation system toward the steady state called climax.

INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20 November 1998; Izmir-Turkey

STATE OF THE ENVIRONMENT IN THE IZMIR BAY

Prof.Dr. Orhan USLU
Director, Dokuz Eylül University, Institute of Marine Sciences and Technology,
35340 Inciralti-Izmir, Turkey.
Tel.: 90-232-278 51 12; Fax: 90-232-278 50 82; E-mail: uslu@ imst.deu.edu.tr

1. INTRODUCTION

The surrounding region around the Izmir Bay in western Turkey has been an excellent place for habitation and for economic development since millennia. The Bay itself can be characterized by its large size and depth, excellent geographic location, good climate, security against the energy of the open sea to the north and of adverse atmospheric influence to the south.

The Bay of Izmir has undergone severe environmental damages in the past decades as a result of rapid urbanization and industrialisation. The influence of industrial and domestic wastewaters of Izmir Metropolitan Area and its vicinity creates a continuous pollution stress on the Izmir Bay. The annual increase rate of the pollution loads is estimated as 5%. In the last years, Izmir Bay has been a focus of concern due to this rapid increase of pollution in the marine environment. Increased eutrophication and pollution with industrial wastes have caused severe ecological problems. If the economic development is not optimised and the assimilative capacity of the bay's ecosystem is not understood the present situation may lead to an ecological collapse. Future sustainable development of the Izmir region will only be possible after proper interdisciplinary investigation elucidating the primary causes for its degradation.

2. THE BASELINE

2.1 The geographical situation

The Bay of Izmir is situated at the western coast of the Anatolian peninsula. It opens to the Aegean Sea along a line in east-west direction. The Bay is roughly "L" shaped with the leg of the "L" about 20 km wide and 40 km long and the base of the "L" about 5-7 km wide and 24 km long (see Fig.1). From the standpoint of its topographical and hydrographical characteristics the Bay is usually considered as consisting of three sections as follows:

- The Inner Bay
- The Middle Bay
- The Outer Bay

Out of practical reasons the Outer Bay is also subdivided into 3 regions.

The Inner Bay starts at the Bay head and extends to the Yenikale lighthouses. A line drawn to the north from that point is the end of the Inner Bay. Densely populated residential and industrial areas surround the Inner Bay. The harbour is in the Inner Bay, which also receives the discharge from the Bornova and Melez drainage basins.

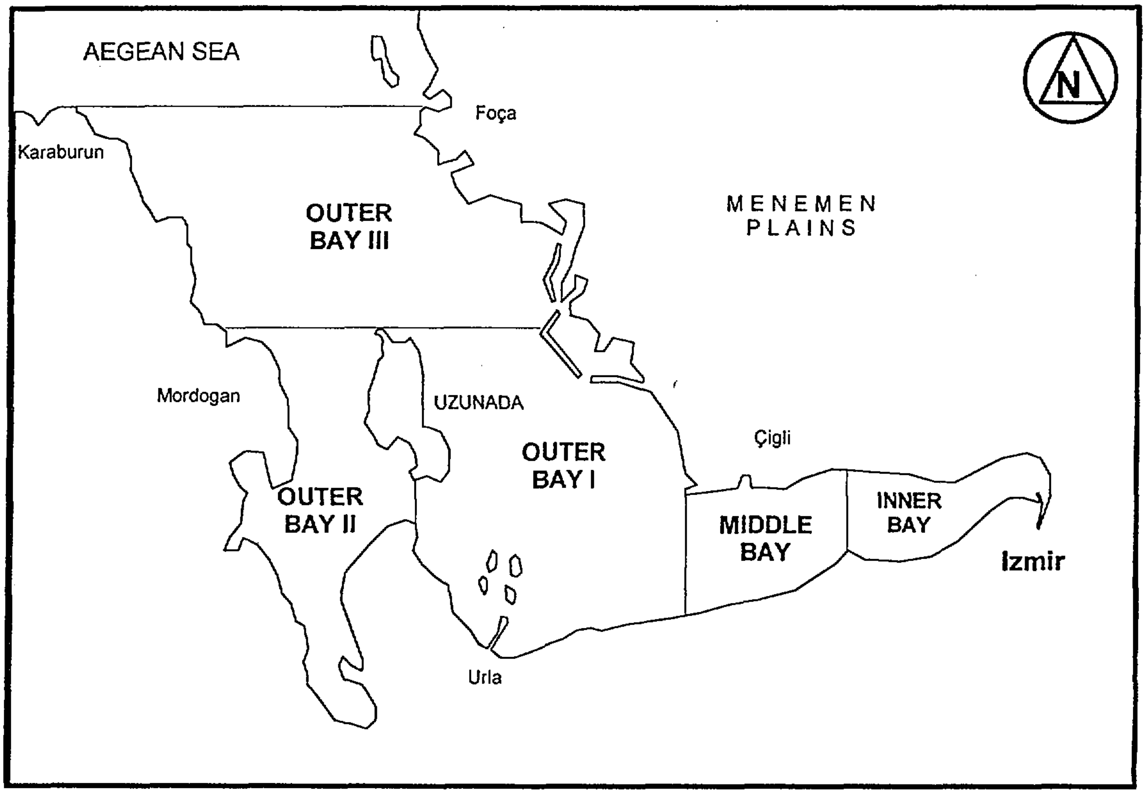


Figure 1: General layout of the Izmir Bay

The Middle Bay extends to Kokala Point. A line that is drawn in a north-south direction marks the end of the Middle Bay. The southern beach shoreline and agricultural areas border it. From south Ali Onbasi Creek and from the north the west and east channels of the Old Gediz River discharge into this section.

The Outer Bay continues to the Bay Mouth. The Outer Bay may also be divided into two subsections: Near Outer Bay and the Far Outer Bay. A line drawn through the Gediz River mouth and northernmost point of Uzun Island indicates the division. The Outer Bay has beaches on both shores. The surrounding areas are densely populated during the summer season. However, during the rest of the year, the influence of tourism is limited.

The water depth of the Inner Bay ranges from 0 to 20 meters. The Middle Bay water depths range from 0 to 40 meters whereas the Outer Bay has relatively constant depth in the N-S direction ranging from 40 to 60 meters over an extension of 25 km. The respective surface areas, volumes and mean depths of these sections are given in Tab.1.

2.2. The catchment area of the bay

The total catchment area of Izmir Bay is about 20000 km². It consists of the catchment of the Bay proper and the Gediz River catchment area. The former includes the Metropolitan Municipality of Izmir and the towns Güzelbahce, Urla, Cesmealti, Mordogan, Karaburun, Foca and Menemen. The Gediz River catchment area, on the other hand, includes the provincial capital of Manisa and the towns Kemalpasa, Turgutlu, Salihli, Ahmetli, Kula and Alasehir.

Table 1: *Surface areas, volumes and mean depths of the bay sections*

Section	Volume (10^6 m^3)		Surface area (10^6 m^2)		Mean depth (m)	
Inner Bay (Harbour region)	*6.7*		*73*		*10.9*	
Inner Bay (Total)		**407.7**		**57**		**7.2**
Middle Bay		**703.8**		**70**		**10.0**
Outer Bay I	*4,862.7*		*168*		*28.9*	
Outer Bay II	*2,007.7*		*136*		*14.8*	
Outer Bay III	*8,383.5*		*235*		*35.7*	
Outer Bay total		**15,253.7**		**539**		**28.3**
TOTAL		**16,365.4**		**666**		**24.6**

Gediz River, which discharges into the Outer Bay, is the major fresh water input of the Bay. Its catchment area is about 18 000 km². The mean annual precipitation on the catchment is 634 mm. The mean discharge from the catchment is 74 m^3/s. At Manisa observation station the discharge is being measured since 1962. The minimum daily average discharge in this time series is 3.8 m^3/s and the maximum daily average discharge is 812 m^3/s. Irrigable land area in the catchment is 2800 km².

Besides the Gediz River, there are many small creeks, which discharge directly into the Bay. The total area of these catchments is 727 km². These watercourses bring only a very limited fresh water input of the Bay. Because of the typically Mediterranean climatic conditions, their discharge is highly variable depending on the season. From June to October the creeks almost dry off. However, their impact on the Bay water quality is significant because of their pollutant loads.

3. PHYSICAL OCEANOGRAPHY OF THE IZMIR BAY

3.1. Temperature and Density

Izmir Bay is a typical Mediterranean estuary with limited fresh water input. As mentioned in the previous section, the main tributary to the bay is the Gediz River. The surface salinity of the Bay waters varies between 37.02 ‰ in January and 39.16 ‰ in October.

The sea surface temperatures are the lowest in January (11.2 °C) and highest in July (26.62 °C). During the summer, the horizontal temperature difference between the Inner and Outer Bay is about 2-3 °C. The higher temperatures increase the rate of biological activity that results in higher ecological stresses during this season.

The density profiles of the Bay are depicted in Fig. 2. From this figure it can easily be seen that the Bay is only stratified during the summer period due to warming up of the upper layers. A thermocline is established at a depth of ca. 20 m during the months June to October. The temperature difference between the surface layer and the hypolimnion in this season rises up to 8 °C. During the rest of the year the Bay waters are vertically mixed.

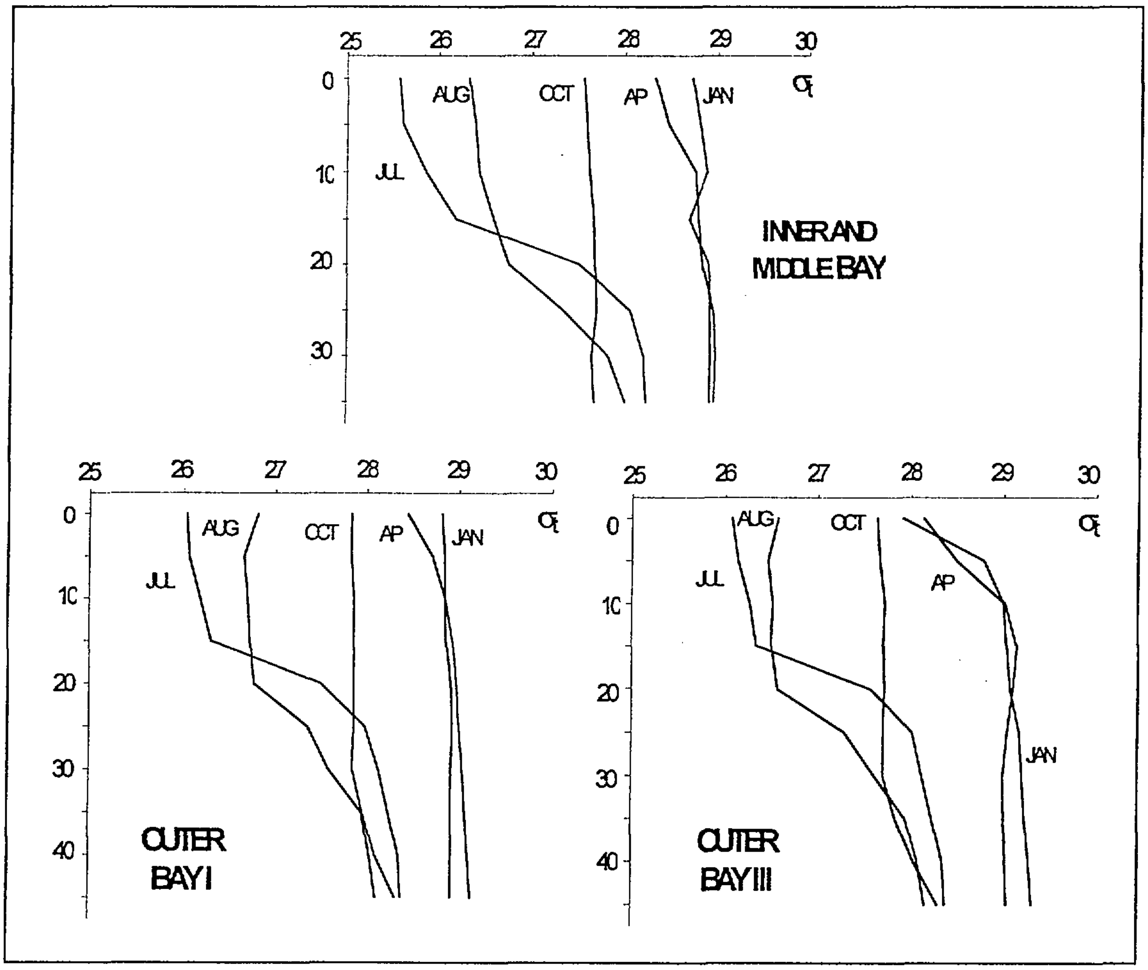


Figure 2: **Izmir Bay density profiles**

3.2. Currents

Currents transfer and disperse the introduced wastes between various Bay sections and ultimately, after several phases of natural reactions, carry them out to the open sea. Both long-term *in situ* measurements with recording current meters and simulation studies with mathematical models have been undertaken to reveal the current patterns in the Bay.

Calibration and validation of the physical component of the model mathematical has been completed in 1997. Princeton Ocean Model's (POM) surface version is used for this study. The importance of this version of POM is the surface elevation, which is taken as a prognostic variable in the model. This gives a possibility to use satellite sea level measurements directly as a boundary condition. TOPEX/POSEIDON data is analysed for this purpose in order to obtain the barotropic part of the velocities. With the inclusion of *in situ* observations full, three-dimensional estimates of the flow field and its properties were reproduced. The model experiments covered the summer and winter seasons. This study has proven that the hydrological part of the POM model is a very powerful tool to give detailed information about Izmir Bay circulation patterns.

From the analysis of currentmeter measurements and the model results, it can be concluded that the Izmir Bay currents are not only driven by wind, but also sea level variations in the Aegean Sea and the seasonal stratification in the Bay play also a very important role to drive the currents.

4. SEA WATER QUALITY

4.1. Turbidity and Particulate Matter

The turbidity values at the coastal stations vary between 250-400 TU, whereas the values range between 20-160 at the offshore stations. The turbidities tend to decrease from the Inner Bay towards the Outer Bay (Fig. 3).

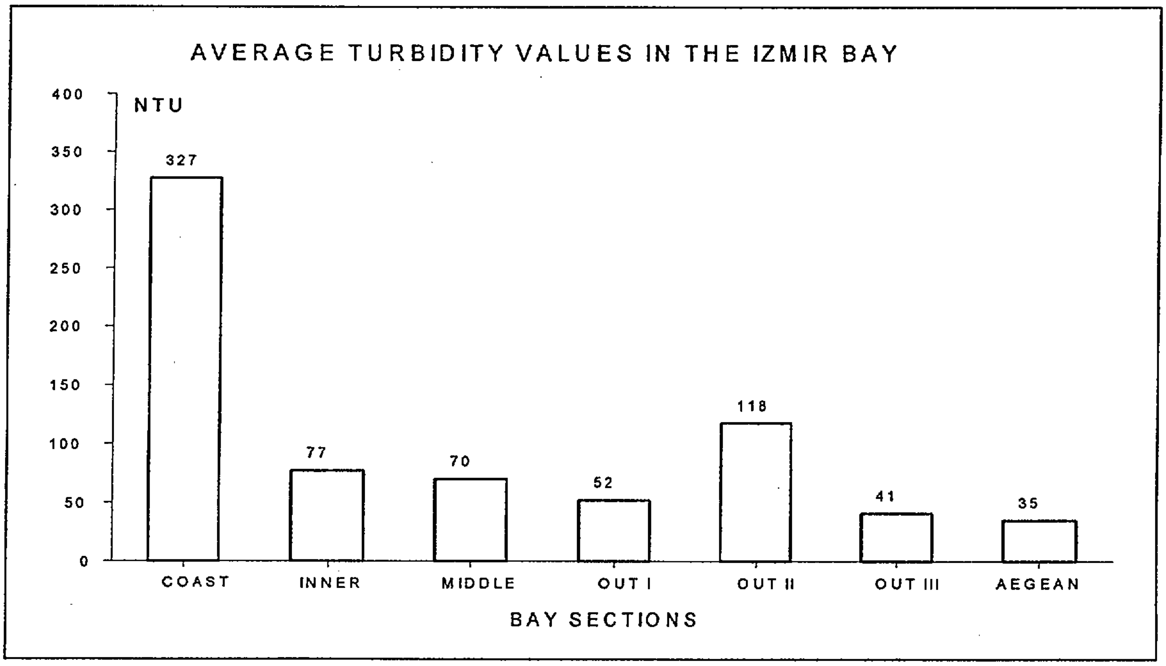


Figure 3: **Average turbidity values in the Izmir Bay**

Secchi disc depths in the Inner and Middle Bay Sections are in the range of 1.00-3.20 m, whereas they increase up to 4.50-19.80 m in the Outer Bay. The particulate matter concentrations at the coastal stations are rather high (>150 mg/l). Particulate matter concentrations change between 10-30 mg/l in the Middle and Outer Bay sections

4.2. pH

In general, the seawater has alkaline characteristics. Higher pH values prevail in the surface layers that are in contact with the atmosphere. Biological activity and the temperature regulate the pH of the seawater. Measured pH levels in the Bay vary in the range of 7.2-8.9. The average value is 8.18 with a standard deviation of 0.30. The pH vales measured in the Outer Bay are slightly lower than those in the Inner Bay. At the mouths of inflowing creeks the pH values as high as 9.78 have been recorded. This increase is due to the influence of highly alkaline industrial wastewaters that are discharge into the creeks.

4.3. Dissolved Oxygen

Dissolved oxygen is one of the most important factors in the marine life and environment. The saturation concentration of oxygen dissolved in water is a function of temperature and salinity. Oxygen is gained from the atmosphere at the air-sea interface or produced biochemically through the photosynthetic activity of the phyto-planktonic species. On the other hand, oxygen is consumed by heterotrophic organisms. This rate of consumption increases as the amount of organic matter in the seawater increases. If the rate of oxygen consumption is higher than the rate of gain, the concentration of dissolved oxygen in water decreases. At dissolved oxygen level below 4.0 mg/l higher organisms such as fish can not survive.

The minimum, maximum, average and median values and standard deviations of dissolved oxygen in the bay sections are summarized in Table 2. The mean values are also depicted in Fig. 4. It is clearly seen that the dissolved oxygen increases from the Inner towards the Outer Bay

Table 2: *Dissolved Oxygen Concentrations in the Izmir Bay (mg/l)*

Section	Min.	Mean	Median	Max.	Std. Dev.
Coastal stations	2.50	4.86	4.63	7.39	1.33
Inner Bay	6.30	7.42	7.42	8.24	0.46
Middle Bay	7.07	7.73	7.74	8.82	0.53
Outer Bay I	7.10	7.87	7.88	8.65	0.44
Outer Bay II	7.38	8.03	8.10	8.72	0.35
Outer Bay III	7.41	8.01	8.10	8.70	0.35
Aegean Sea	7.32	7.98	7.96	8.72	035

It is interesting to note that the dissolved oxygen even in the highly polluted Inner Bay, in average, is above the critical limit. However it should be noted that the levels are rather low at the coastal stations. This is due to untreated domestic and industrial wastewaters that are directly discharged from the shores or via creeks that flow into the bay. These discharges are rapidly mixed into the receiving waters.

Dissolved oxygen concentrations exhibit also seasonal variations. Since the biochemical activity is higher during the warmer seasons, the oxygen consumption of the heteretrophs is also higher. As a result, the dissolved oxygen concentrations assume their lowest values during the summer.

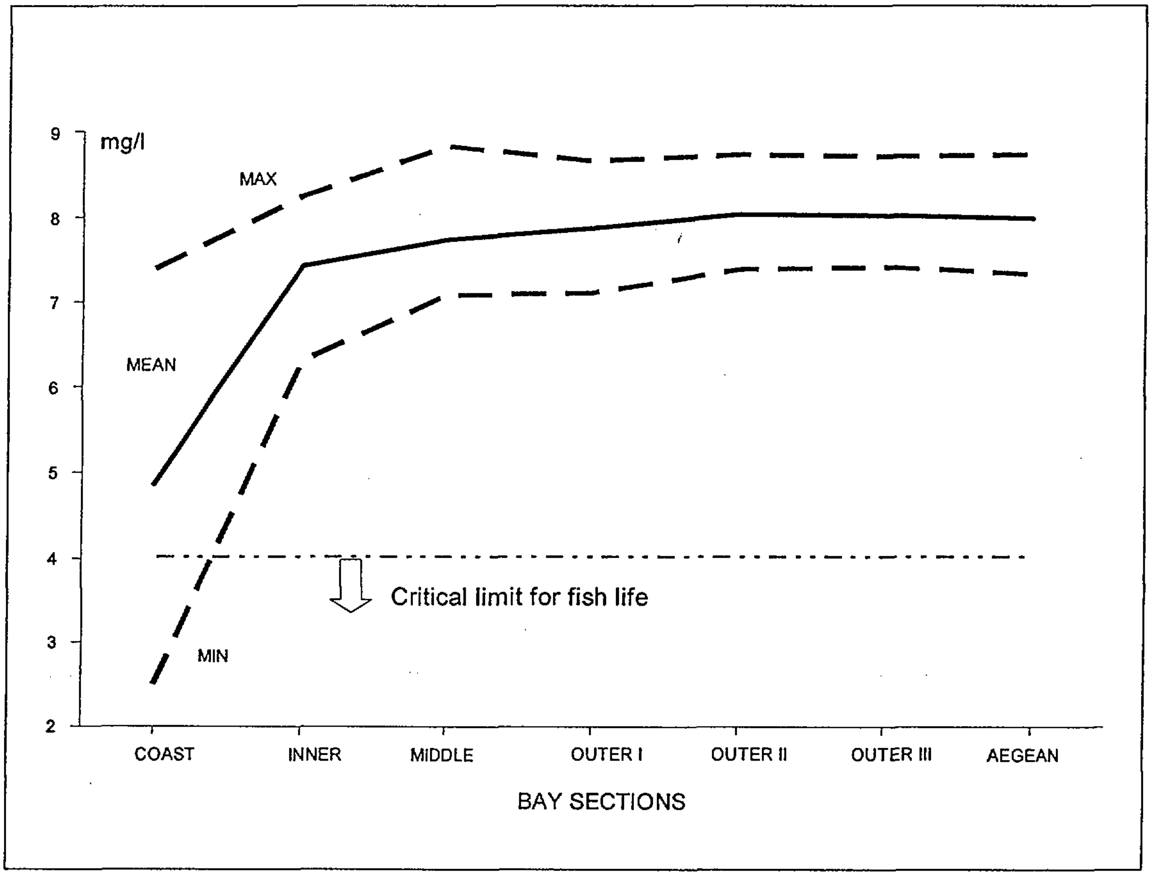


Figure 4: **Mean monthly dissolved oxygen concentrations in the Izmir Bay.**

The dissolved oxygen concentrations discussed in this section are spatial and temporal averages of the values measured within monthly periods. The individual values may be lower at individual stations. Indeed, values measured at the coastal stations of the Inner Bay during summer are many instances as low as 0 mg/l. Anoxic conditions prevail at these locations.

In the vertical direction, dissolved oxygen does not vary much in the Outer Bay. However the concentrations in the summer show a sharp decline along the depth both in the Inner and Middle Bay.

4.4. Organic matter

Organic matter in the Bay has been measured in terms of Biochemical Oxygen Demand (BOD_5). In general the values vary in the range 5-15 mg/l. However values as high as 150-280 mg/l has been measured at the coastal stations of the Inner Bay. These elevated values are due to discharges of untreated wastewaters. The composition of organic matter in various bay sections is different. In the Inner Bay the origin of organic matter is the untreated wastewater discharge. Moving towards the Outer Bay, the photosythetically produced organic matter (mainly phytoplankton) takes the overhand.

4.5. Nutrient elements (nitrogen and phosphorus)

The total nitrogen concentrations in various bay sections range between 1-20 μmol/l. At the coastal stations the values rise occasionally to levels as high as 650 μmol/l. In general, total nitrogen decreases towards the Outer Bay. Similarly, total phosphorus values are in the range of 0-7.5 μmol/l whereas the values as high as 80 μmol/l have been measured at the coastal stations in the Inner Bay. The overproportional increase of nutrients at the coastal stations is due to wastewater discharges.

The distribution of nitrogen species, total phosphorus and N:P ratios at various bay sections are given in Tables 3 to 7. N:P values serve to determine the limiting nutrient in aquatic environments.

Table 3: *Ammonia nitrogen concentrations at different bay sections (μmol/l)*

Section	Min.	Mean	Median	Max.	Std. Dev.
Coastal stations	10.6	224.8	220.6	484.5	131.9
Inner Bay	0.90	9.97	6.20	29.25	8.95
Middle Bay	0.44	3.18	2.66	6.22	1.86
Outer Bay I	0.20	2.22	1.60	8.37	2.31
Outer Bay II	0.17	1.56	1.24	5.90	1.51
Outer Bay III	0.23	2.10	1.65	5.01	1.52
Aegean Sea	0.24	1.48	1.13	5.50	1.42

Table 4: *Nitrite nitrogen concentrations at different bay sections (µmol/l)*

Section	Min.	Mean	Median	Max.	Std. Dev.
Coastal stations	0.36	7.48	5.17	32.49	8.57
Inner Bay	0.08	1.96	0.88	6.38	2.04
Middle Bay	0.08	1.16	0.40	6.20	1.59
Outer Bay I	0.06	1.38	1.12	4.00	1.37
Outer Bay II	0.03	1.47	1.90	3.80	1.40
Outer Bay III	0.06	0.20	0.16	0.61	0.14
Aegean Sea	0.07	0.19	0.14	0.58	0.14

Table 5: *Nitrate nitrogen concentrations at different bay sections (µmol/l)*

Section	Min.	Mean	Median	Max.	Std. Dev.
Coastal stations	0.35	3.92	2.31	14.88	3.45
Inner Bay	0.38	2.79	1.68	10.78	2.83
Middle Bay	0.68	2.24	1.40	5.50	1.57
Outer Bay I	0.40	2.14	1.95	4.75	1.23
Outer Bay II	0.11	1.58	0.44	12.70	2.77
Outer Bay III	0.30	2.72	1.08	11.72	3.51
Aegean Sea	0.21	3.78	0.94	22.26	6.50

Table 6: *Total phosphorus concentrations at different bay sections (µmol/l)*

Section	Min.	Mean	Median	Max.	Std. dev.
Coastal stations	1.21	21.13	19.82	84.09	18.81
Inner Bay	0.04	2.42	1.67	7.37	2.04
Middle Bay	0.03	1.27	1.10	4.01	1.06
Outer Bay I	0.26	1.03	0.77	2.66	0.69
Outer Bay II	0.01	1.11	0.90	3.17	0.98
Outer Bay III	0.01	1.16	0.76	3.84	1.25
Aegean Sea	0.01	1.20	0.72	7.12	1.56

Table 7: *N:P ratios at different bay sections (µmol/µmol)*

Section	Min.	Mean	Median	Max.	Std. dev.
Coastal stations	5.56	7.68	7.52	10.84	1.40
Inner Bay	3.60	6.78	6.43	10.90	1.97
Middle Bay	3.16	6.10	5.54	9.00	1.72
Outer Bay I	5.33	10.51	10.12	22.07	3.64
Outer Bay II	2.55	8.10	6.75	27.39	4.96
Outer Bay III	3.84	9.63	10.12	17.02	3.53
Aegean Sea	4.40	9.26	8.03	18.01	4.01

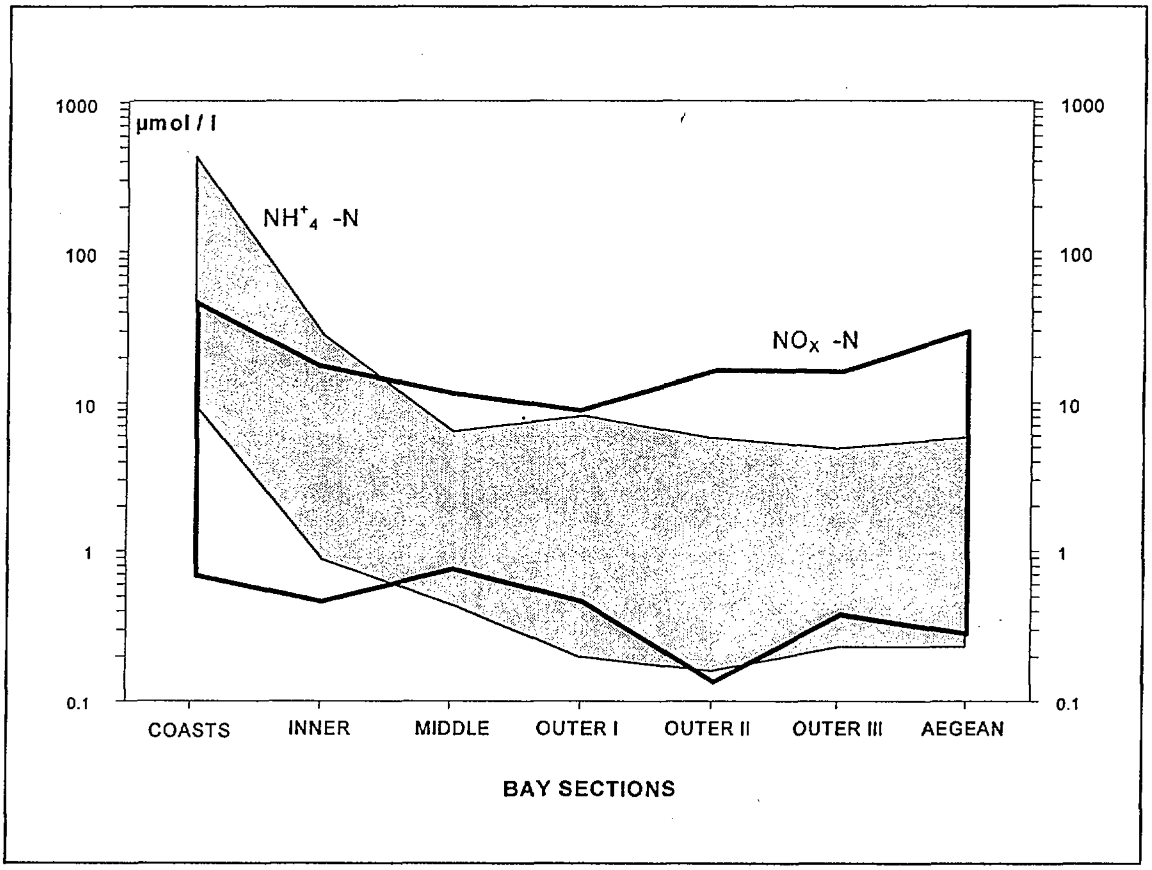


Figure 5: *Distribution of nitrogen species in the Izmir Bay*

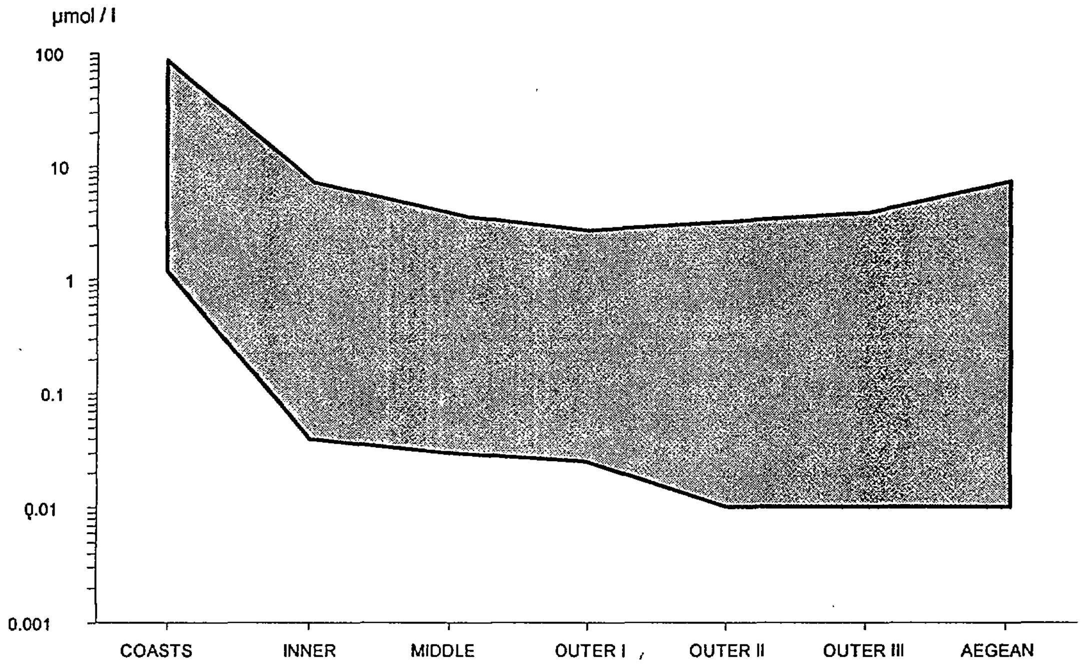


Figure 6: *Distribution of total phosphorus in the Izmir Bay*

The relationships and spatial variations between nitrogen and phosphorus species are depicted in Figs 5 and 6. It is seen that moving from the Inner Bay towards the Outer Bay the nutrient concentrations, both nitrogen and phosphorus are decreasing. Furthermore, there is a shift between the nitrogen forms. Whereas ammonia nitrogen (NH^+_4-N) is the dominant species in the Inner Bay due to recent discharges, nitrate nitrogen (NO^-_3-N) becomes dominant towards the Outer Bay because of biogenic nitrification processes taking place in consecutive bay sections.

Simultaneous nitrogen and phosphorus determinations in the Bay sow that the N:P ratios generally change in the range of 5:1 - 10:1 µmol/µmol. The assimilative optimum in the ocean is 16:1. The measured values allow the conclusion that the bay waters are rich with respect to phosphorus and nitrogen is the limiting nutrient. Increasing the nitrogen inputs would increase the already present state of eutrophication in the bay.

The phosphorus concentrations of Mediterranean surface waters are extremely low (<0.03 µmol/l). Incipient eutrophication in coastal water is signaled at concentrations of 0.15 µmol/l, whereas highly eutrophic coastal systems have concentrations above 0.30 µmol/l. On the other hand, the nitrogen concentrations in the open Mediterranean waters are <0.1 µmol/l for NO^-_3 , <0.5 µmol/l for, NH^+_4 and <0.1 µmol/l for NO^-_2 . These concentrations increase twofold in eutrophic waters and fivefold in hypertrophic coastal waters. At river mouths and coastal waters polluted by wastewater discharges it is possible to find NO^-_3 concentrations in excess of 35 µmol/l and NH^+_4 concentrations above 20 µmol/l (UNEP, UNESCO, FAO, 1988). Grace (1978) gives the limits of incipient eutrophication as 0.5 mg/l (35 µmol/l) for nitrogen and 0.015 mg/l (0.5 µmol/l) for phosphorus.

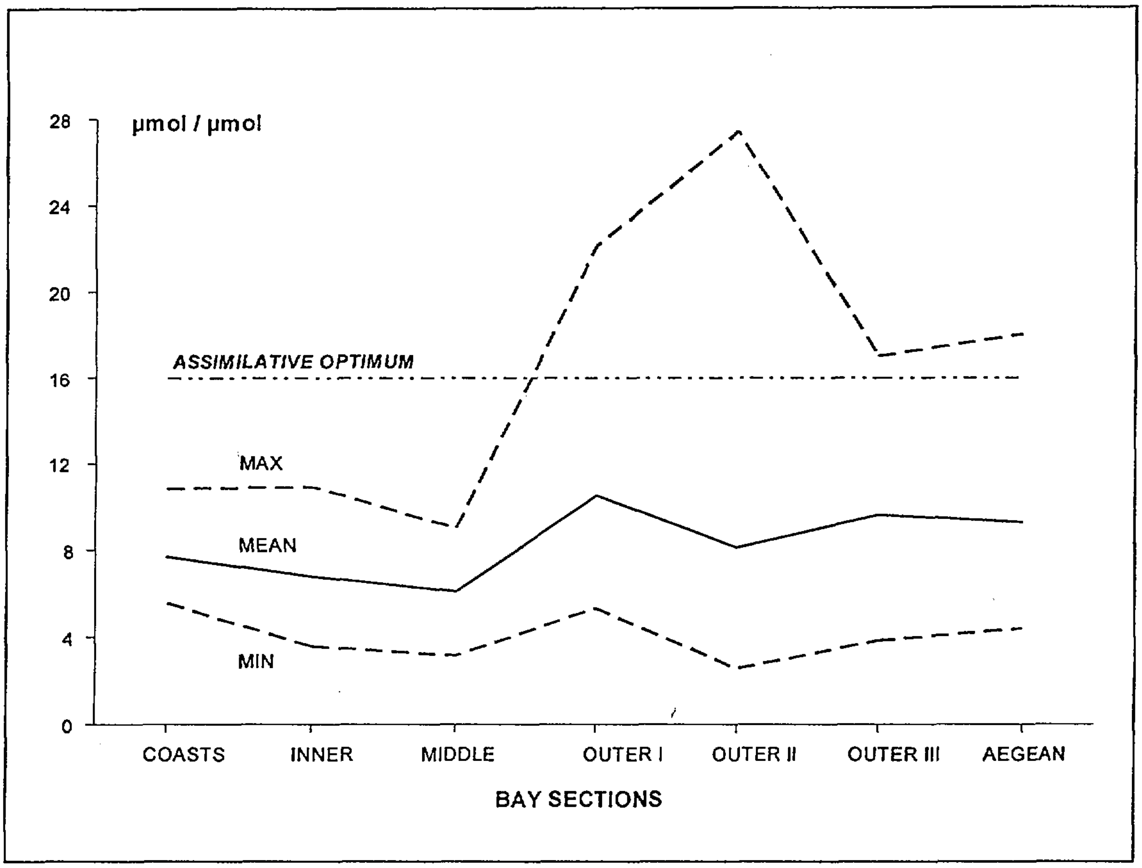


Figure 7: *N:P ratios in different bay sections*

Specifically for phosphorus the thresholds given in both of the above references are exceeded. The peak values encountered in the Inner Bay and at the Gediz River mouth in the Outer Bay signify that these elevated levels are due to domestic and industrial wastewater discharges in the first instance and due to agricultural influences in addition to wastewaters in the second case.

The levels of primary productivity in the seas around Turkey are shown in Fig. 8 (Uslu, 1993). In the offshore areas the average primary productivities are >200 gC/m²/year in the Black Sea, 100-40 gC/m²/year in the Marmara, 30 gC/m²/year in the Aegean and <25 gC/m²/year in the Mediterranean seas. The eutrophied waters especially in the Turkish bays are well above the offshore references. Productivities between 40-300 mgC/m²/h in the Inner Bay and 7-30 mgC/m²/h in the Outer Bay have been measured (Geldiay, Uysal, 1978). It has been estimated that the organic matter production of the bay due to anthropogenic nutrient inputs is several times more than the direct inputs of organic matter contained in wastewaters.

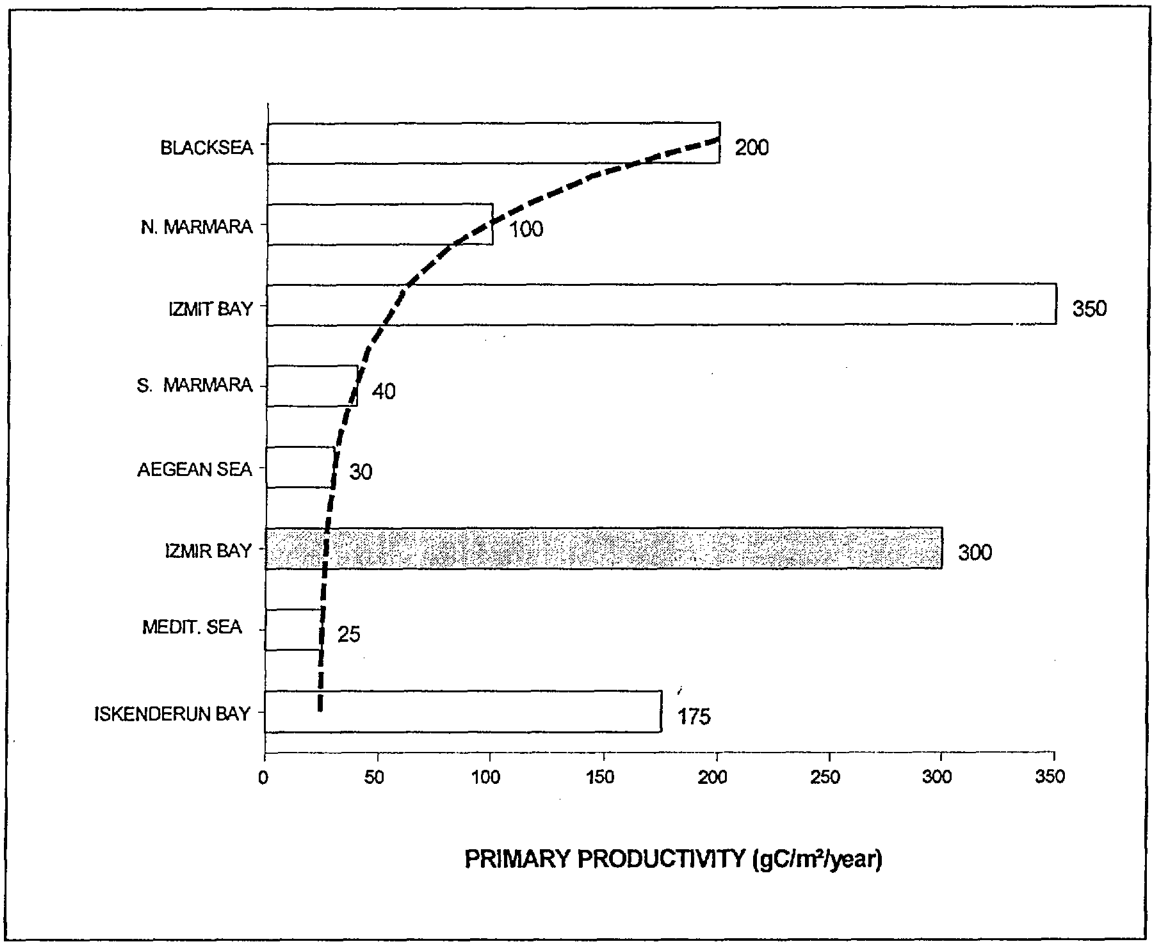


Figure 8: *Primary productivities in the seas around Turkey.*

4.6. Pathogens

Pathogenic microorganisms and viruses introduced into aquatic environments by means of fecal discharges constitute a hygienic risk. For engineering purposes it is unmanageable to try to detect every single species of these organisms. For this reason, it is considered as appropriate to monitor indicator organisms that signify fecal contamination. The most widely used species for this purpose are coliform bacteria.

The average values of fecal coliform concentrations measured in the various sections of the bay are depicted in Fig. 9. The Turkish standards for recreational waters give 200 F.coli per 100 ml as the upper limit (Water Pollution Control Regulations, 1988). This standard is exceeded in all Bay sections. On the other hand, the European Union regards 2000 F.coli per 100 ml as still acceptable for recreational purposes and body contact. According to the latter, the Outer Bay is still acceptable for recreation.

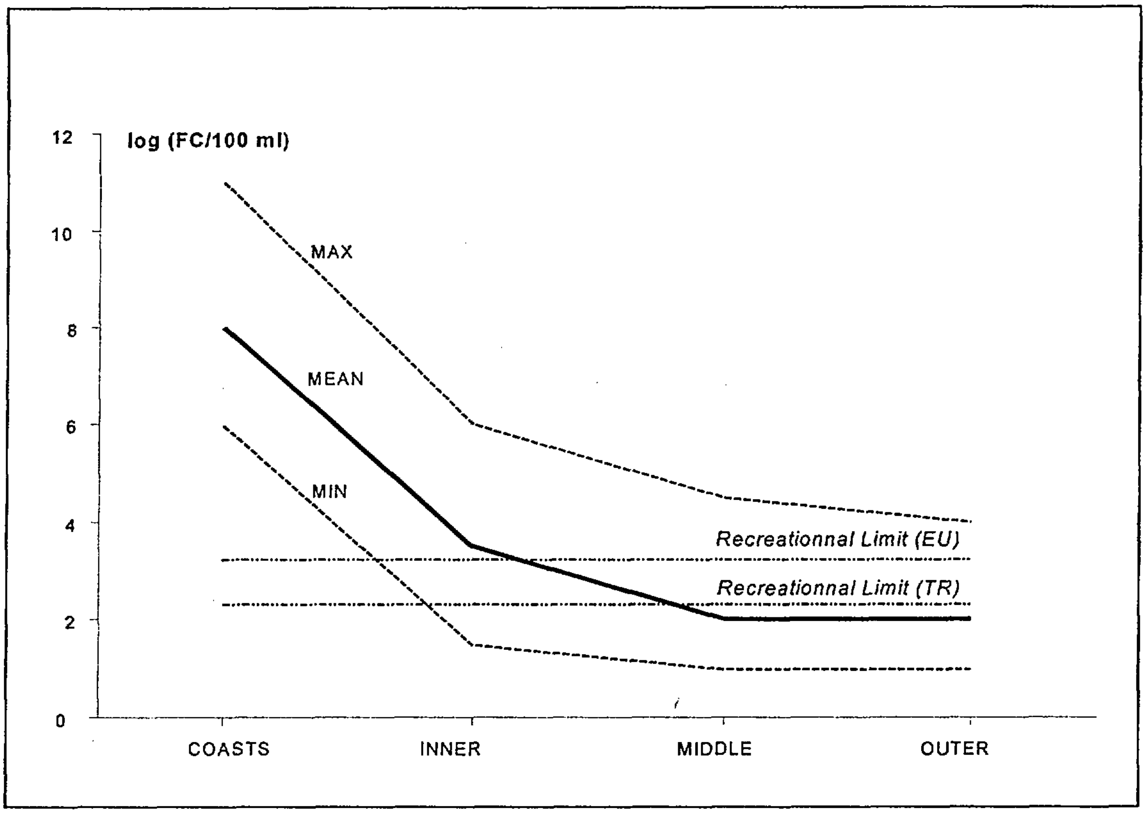


Figure 9: **Fecal coliform concentrations in various bay sections.**

5. SEDIMENT QUALITY

The quality of Bay sediments has been extensively studied at the IMST. The results have been published in a recent paper (Aksu, *et.al.*, 1998). The concentrations of 42 elements in 84 samples established that surface sediments in the inner Izmir Bay display significant enrichments in Ag, As, Cd, Cr, Cu, Hg, Mo, Pb, Sb, Sn, V and Zn, associated with notably high concentrations of P, total organic carbon (TOC) and sulphur (S). Organic geochemical data in 14 samples from inner Izmir Bay showed that these sediments also exhibit significant enrichments in polycyclic aromatic hydrocarbons and polychlorinated dibenzo-d-dioxins and dibenzofurans. Combined inorganic and organic geochemical data indicated that Inner Izmir Bay surface sediments are extremely polluted and probably pose high risk to the resident marine biological community. The results of these investigations are given in Tables 8 to 10

Table 8: *Heavy metals in Izmir Bay sediments*

Element (mg/kg)	Pre industrial Background	Natural concentrations in clays	Inner Bay	Outer Bay I
Ag	0.05	0.07	0.2-1.0	0.2-0.5
As	10.00	13	30-60	20-50
Cd	0.03	0.22	0.2-0.8	0-0.6

Cr	175.00	39	250-600	150-300
Cu	17.00	39	20-80	15-40
Hg	0.05	0.18	0.2-1.5	0-0.6
Mo	1.00	2.6	2-10	0-3
Pb	8.50	23	20-60	15-30
Sb	1.00	1.5	2-8	0.5-3
Sn	2.00	6	2-10	0-4
V	60.00	130	110-170	130-160
Zn	65.00	120	50-350	50-150

Table 9: ***Volatile matter (LOI), Tot-N and Tot-P contents of the Bay sediments***

Bay	LOI	Total N		Tot P		N:P
Section	%	mg/kg	mmol/kg	mg/kg	Mmol/kg	mmol/mmol
Inner Bay	10.5	3500-4700	250.0-335.7	580-650	18.7-21	18.3
Middle Bay	10.7	2500-3400	178.6-242.8	570-640	18.4-20.6	9-12
Outer Bay	7.0-9.0	1000-1200	71.4-85.7	250-280	8.1-9.0	7-9

Table 10: *Organic matter in Izmir Bay sediments*

	Inner Bay	Yenikale Entrance	Central Bay
TOC (%)	>7	3	2
LOI (%)	18		8
Total PCDD(1) (ng/g)	>0.55	0.07-0.09	<0.04
Total PCDF(2) (ng/g)	0.06	0.04	0.03
PAH (μg/g)	9.27	1.25	0.42

(1) *polychlorinated dibenzo-p-dioxins*
(2) *polychlorinated dibenzo-furans*

6.PRESENT POLLUTION INPUTS TO THE BAY

Izmir Bay, starting in the 1960's entered a period of rapid pollution and today, from the point of view of aesthetics health, it has become one of the most important pollution foci in Turkey. The causes of this pollution are the phenomenon of extremely rapid and uncontrolled urbanization as a result of fast population growth and, parallel to this, the advent of industrialisation. The pollution loads that cause pollution in Izmir Bay consist of six main components:

a) Domestic wastewaters
b) Industrial wastewaters
c) Surface runoff
d) Agricultural drainage
e) Port activities and sea traffic
f) Pollution input of streams flowing into the Bay

Being mainly point sources, only the first two of the previously mentioned components bear the characteristics of being directly controllable and manageable.

Incoming loads from households and industries are given in Tables 11 and 12.

Table 11: *Loads originating from households and industries (DEÜ, 1985).*

Year	Population	Wastewater Discharge	BOD	SS	Total-N	Total-P
	millions	m^3/day	Tons/day			
1985	1.596	338000	214	166	8.45	2.10
1995	2.164	538000	303	246	13.45	3.54
2005	2.687	771000	399	330	19.28	5.24
2015	3.267	1066000	495	415	26.70	7.44

Table 12: *Heavy metal inputs into the Bay (Balkaş ve Yetiş, 1992)*

Creeks	Cr (kg/year)	Cd (kg/year)	Hg (kg/year)
Bostanlı	19-73	0.5-1.4	0.7-2.4
Ilıca	26-100	0.6-2.0	0.9-3.3
Bornova	26-100	1.0-2.4	1.8-12.9
Manda	120-210	1.5-3.0	2.2-10.7
Arap	217-790	0.9-2.9	1.3-4.5
Halkapınar	26-100	0.7-2.0	0.9-3.3
Melez	440-4400	1.5-5.1	0.9-23.4
Poligon	5-19	0.1-0.4	0.2-0.6
Old Gediz	55-210	1.4-4.1	1.9-6.9
Total	934-5929	8.2-23.3	10.8-75.3

7. CONCLUSIONS

The characteristics of the Izmir Bay as a receiving medium for wastewaters of well as the characteristics of pollutants discharged into the Bay can be summarized as follows:

a) Izmir Bay, particularly the Inner Bay has a very limited waste assimilation and dilution capacity.

b) Because the pollution loads are increasing with time, the region, which is influenced by waste inputs, is gradually broadening. If preventive action is not started immediately, this process is expected to persist and accelerate in the future.

c) Especially in the Inner Bay, the accumulation of mud at the mouths of streams and the high concentration of organic matter both in the sediments and in the water column has given rise to very negative results in this section from the point of view of smell and aesthetic appearance.

d) Pollution inputs into the Bay have different weights according to their origins. Presently the organic material load introduced by the industries is almost as much as the load originating from the households. Domestic sources are mainly responsible for nutrient inputs. Industries, on the other hand, contribute to the heavy metal inputs almost exclusively.

e) Besides the organic constituents that are directly disposed into the Bay at the present time, nitrogen and phosphorus contained in the wastewaters increases the primary productivity significantly. This phenomenon of secondary pollution augments the organic loads of the Bay especially in the inner sections.

f) Heavy metals contained primarily in industrial wastewaters form an inordinate risk factor for the Bay ecosystem.

Solutions to the problems created by increasing population and industrialization have two facets. The first of these is the realization that the environment is a resource that can be exhausted. While the second aspect is that the environmental problems which are created as a result of technological and industrial activities can be attacked by scientific and technological prevention measures.

The techniques developed in various fields of oceanography, environmental science, information technology, systems analysis, mathematical modeling and remote sensing have to be unified to attain a powerful integrated approach to cope with the complex problems at the coastal zone. Although this is a relatively well known truth in the scientific community, most of the recent applications are mostly lacking this integrity and scientific basis. As a result, management practices in the coastal zone remain limited to some approaches with main emphasis on some economic and social components with rudimentary pseudo-scientific linkages.

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THE IMPORTANCE OF INVOLVING KEY STAKEHOLDERS IN THE DECISION MAKING PROCESS FOR COASTAL AREAS

Louis F Cassar, ICS/UNIDO

The notion of tackling linkages between environmental and development issues dates back to, at least, the Stockholm Conference of 1972. During this landmark meeting on Environment & Development, vague terms such as 'eco-development' and `environmentally sound development' evolved. During the years that followed, international agencies such as UNEP worked hard to define a terminology that would encompass the implications of Environment and Development.

In March of 1980, the first World Conservation Strategy endeavoured to integrate the two concerns into an umbrella concept of Conservation. As the interest generated gathered momentum, the concept of sustainable *development* evolved some years later. The question of whether sustainable development can be attained in a serious and tangible manner still draws a fair degree of skepticism. However, the need to implement development plans with added responsibility towards the environment is now recognized by most decision-makers as an important element for the integrated management of natural resources.

In the past, the traditional approach to planning and management of the coastal environment and its resources has been to target activities, such as fisheries, mineral extraction, shipping, industrial and other uses - all economic activities. This resulted in the fact that planning for environmental protection and conservation received low priority. More recently however, there has been a shift towards integrated planning, and, recognition that environmental management is essential for affording adequate protection to ecologically important coastal sites.

Population expansion has already had a notable effect on coastal systems, particularly in the Mediterranean, where increasing pressures on natural areas have led to changes in land-use patterns. Such land-use conflicts, often, make demands on ecological resources that are unsustainable.

Clearly, the capacity of Mediterranean ecosystems to replenish resources and absorb waste will eventually be outpaced by demographic growth and accompanying activities, including industrial development, thus, constraining future economic growth and development in the region. Worse still, projections indicate that the pressure is expected to intensify, with coastal populations likely to more than double by the year 2025, that is, from just under ninety million at present to between 150 and 170 million; the number of tourists is expected to reach 260 million per annum.

Concern over the rapid depletion of the region's environmental resources, and the implications of this loss for the biosphere and human welfare, has been mounting for years. For this reason, a series of activities, relating to integrated coastal area management, has been undertaken in recent years. One such area is that of inventorying and monitoring of both natural and man-induced changes in the environment. Through this, a baseline can be established for describing the patterns of change in biotic communities as well as in the ecosystem itself. Such information can then be incorporated into management plans where decisions (based on concrete facts and findings, rather than just educated guesses) can be made concerning the effects of different uses and levels of use. Monitoring of environmental conditions will shed information about land-use patterns and changes within and around the site.

A monitoring programme may consist of any number of appropriate information gathering techniques such as cursory assessments, large-scale surveys and intensive inventories, or computer-aided technologies. Whichever method is used, it is important that environmental management is conducted with appropriate backing data. The contrary will result in the inability to determine carrying capacities of the ecosystems in question, as well as lead to haphazard management decisions. It is likewise important to integrate all activities, their inputs and outputs, into a comprehensive area management programme; this can only be achieved through system planning.

System planning indicates the overall problems facing species, communities, habitats, ecosystems, and, people and their activities. It is the starting point for conservation and development and should integrate the two.

- For development, system planning indicates areas needing special management to sustain both human development and environmental stability, and indicates how, where, and when certain development activities will have negative and positive effects on the environment.
- For conservation, it indicates the present and future vulnerabilities of renewable resources and identifies habitat areas most urgently in need of protection. The result of system planning is selecting specific sites for protection and defining their purposes and objectives.

Similarly, one of the primary roles which emerges as a response to fundamental concerns which mark the implementation phase of the Biosphere reserve concept - the development role - searches for rational and sustainable use of ecosystem resources and, as a result, enhances a close cooperation with the human populations concerned.

A multi-faceted plan will effectively involve *nature conservation,* the *management of natural* resources *through existing* legislation, and the socio*economic requirements of the* stakeholders. As much as possible, every effort should be made to seek common ground, although often difficult, among opposing groups, since neither nature conservation nor economic activity can be efficiently managed without a certain amount of interaction between the two.

Framework for action - Lack of streamlining among national environmental agencies, inadequate legal instruments coupled by ineffective enforcement, weak public information systems and failure to incorporate Environmental Education in school curricula and within in-service training courses for both the public and private sectors are key elements responsible for the prevailing situation in most developing countries of the Mediterranean.

- inadequate flow of information to the public
- lack of grassroots involvement including weak consultations with NGOs

- Environmental Education - too low a priority

Reliable techniques for quantifying the value of environmental services and the long-term costs of resource degradation need to be developed in line with local requirements. Also required are improvements in the current analysis of natural resource and development issues, so that their relevance to the economic, social and cultural impacts can be clearly demonstrated. Furthermore, the creation of incentives, the decentralization of management systems and, where appropriate, increased involvement by industry and nongovernmental organizations all need to be included in improved national policies (CASSAR,1994).

All of these and more fall within the ambit of the strategic planning process, which should include (i) ***information assembly and analysis;*** **(ii) policy formulation; (ii) action planning, (iv) implementation; and (v) monitoring and evaluation.** Each of these components should be driven and facilitated by **participation** and **communication**.

A basic management mechanism for most strategies is a steering committee, made up of policy-makers, specialists, and representatives of all the stakeholder groups. Although the composition, size, terms of reference and functions of such bodies would vary according to specific tasks, experience suggests some general rules since the initiation phase of any strategy can be a time of frustration. Well-targeted, decisive but diplomatic management at an early stage can determine the level of success of any plan in its later phases.

Once the political decision has been taken to pursue a strategy for sustainable development, the main actors need to have a common understanding of the way forward. Although government environmental agencies, experienced specialists, and possibly NGOs will probably be taking the primary responsibility for managing the process, it is very important that all of the key stakeholders, including the **affected locals** and **resource users,** become involved from the very start.

Political support - Decisions on how coastal areas are apportioned for different uses, or how much money should be allocated to public amenities, fall within the domain of politicians. In many countries, where public opinion is deemed important, many politicians have joined, or appear to have joined, the ever-growing ranks of the conservation conscious - their political life depends on public support. In cases where the political decision-maker may have to take an unpopular stance on a controversial issue related to environmentally sensitive areas, an informed public could influence decisions on conservation issues and thus rally the political support necessary to declare and maintain, for example, protected areas (BARZETTI,1993).

Public support in such cases can take the form of direct or indirect pressure on political decision-makers.

- Direct pressure may involve the provision of information to politicians that will enable them to convince their peers of the importance of establishing protected areas. Until recently, economic reasons tended to be the common justification. However, social arguments are rapidly becoming more validwhile hard-core sciences provide the baseline data on the scientific importance of a particular site, the data from the social sciences (anthropology, sociology, geography, political science and psychology) can provide political decision-makers with a clearer picture of the integral role protected areas play in the social and economic life of the nation.

- Indirect pressure often takes the form of public opinion that influences political decisions. In this arena NGOs can play a crucial role, in particular since they tend to be independent of official political and economic interests. Additionally, NGOs represent a sector of the population.

Support could also be derived from among the stakeholders in and around environmentally sensitive areas, mostly from 'affected locals'. Resource users can likewise provide additional public support. Those benefiting from a protected area will 'defend' it against incompatible uses, and often support management structures designed to maintain the resources from which their benefits derive. This often results in their being among the staunchest supporters of the project.

There is, of course, no single correct way of implementing a strategy, and many approaches exist. The objective is to be pragmatic and incremental aiming not for perfection but for constant improvement. The accent on participation cannot be overstressed. It is important to remember that *participation,* which together with *communication,* are key driving forces of all the elements, which make up the strategic planning process. This needs to involve as many people as possible from all sectors of society. However, "If a strategy were to start off by attempting to involve everybody, it would quickly become bogged down and exhausted of its resources. Participation in the first cycle of the strategy may involve only a few key sectors of society but can be widened as the strategy develops".

Inevitably, strategies are processes, which require optimization and opportunism, and often require getting involved in somewhat difficult administrative and political situations. In view of their complexity, strategies must cater for varying interests, and offer mechanisms for trade-offs. An important aspect when negotiating with **affected locals** and **resource-users**, is the consideration of the will of a minority.

On occasions a sector of a community (e.g. fishermen, farmers etc.) or simply private individuals may have a different point of view from the majority of stakeholders. In such cases allowances should be made for minority desires. That is, every effort should be made, where agreement by consensus is unattainable, to understand and integrate fundamental requests by these groups.

Conflict resolution: Invariably, in planning coastal areas and in proposing legislative measures, that is, controls and restrictions, some stakeholders may offer resistance (either in the way of protest or, even, physical) to certain schemes. This may be due to lack of information, egoism, political instigation or, quite simply, genuine concern. This usually leads to conflict between the affected stakeholders and the government agencies, and sometimes even with environmental NGOs.

Human nature has it that once an individual or group takes a position and defends it strongly, it may then prove exceedingly difficult for the planner/mediator to convince the opposing party to back down from it. Good conflict resolution needs to first distinguish between peoples' *interest* and their *positions* - an interest is a fundamental need or concern; while a position is an idea put forth to further one's interests (LEWIS, 1993).

For example, a farmer who may be growing crops on agricultural land adjacent to an active dune system finds that sand blowing inland is constantly affecting his yield.

- His first position would be to plant fast growing alien tree species such as Eucalyptus or Acacia on the dune ridges to prevent sand blowing over his landin doing so, the newly planted trees would effectively be competing with the dune vegetation and also affect the area's hydrological balance, in view of the large amounts of water these particular species are reputed to utilize.

- Alternative positions would be to fence in his crops or to request, from government, compensation for damages. Thus, the farmer's interest is the same, that is, of protecting his crops, but his position may change.

In addition to focusing on each party's interests rather than positions, policymakers need to address the issue of *power* in the conflict. This can come in many forms - personal, political or economic power or influence, or it can be the power of information, legal or `strong-arm' backing. It is important to be conscious of the *real* and *perceived* power of the stakeholders involved in the conflict, as they will act according to their own perceptions of the power balance. It is therefore to be ensured that all significantly affected stakeholders are included in resolution discussions. In addition, understanding their interests and power positions will go a long way toward helping resolve existing disputes.

Ideally and whenever possible, it is best to avoid conflict in the first instance. This can be achieved by preparing adequately, during the initial planning phases, for potential areas of conflict: First, by consulting with potentially affected stakeholders and including their active participation in the coastal area's management issues, and secondly, by being somewhat flexible and adaptable to local circumstances.

NGO involvement - Although coastal planning falls within central government jurisdiction, it is often well worth considering vesting environmental NGOs with management and up-keep responsibilities. Two constraints, which readily come to mind, if central government should attempt to manage coastal areas alone, are:

(i) Funding for management of such areas often falls victim to short-term national development goals, as a result of which coastal areas end up without management plans or adequately trained, personnel; and,

(ii) Being multi-disciplinary by nature, coastal areas require inputs from different disciplines for their effective management.

Conservation oriented non-government organizations are becoming increasingly more active in collaborating with government environmental agencies with regard to protection efforts. NGOs tend to have advantages that can compliment governmental management efforts.

These include:

- NGOs are less bureaucratic than official agencies and therefore more flexible in their management;

- NGOs may have more hands-on and scientific expertise than government departments;

- NGOs have access to funding sources not usually offered to governments;

- NGOs can raise funds for direct use in conservation areas as opposed to government, who must direct all revenue to the national treasury;

- NGOs are usually less politically influenced than government departments.

There are several situations where NGOs can actively become involved in the management of ecologically important coastal areas, the more effective management models being: intervention-oriented or interactive, where international NGOs' or donor agency assistance is sought. The first involves the seeking of international aid by a national NGO in order to proceed with its conservation agenda; the second option involves mutual sharing of tasks in executing a management plan. The most feasible model, which applies to developing countries, appears to be the one in which government is the landowner but where it cedes the management functions, under appropriate supervision, to a competent NGO or body of NGOs.

In such a case, the larger the coastal area the more diluted is its management effectiveness. The challenge to effective site management is to establish zoning schemes that identify priority sites for specific uses and enhanced protection levels - the introduction of international area delineation criteria (such as those used by MAB) can be used on the macro-scale, while AEI and SSI ratings can be used to further highlight small but important ecological areas for management purposes.

Biodiversity Corridors: In many locations in the Mediterranean where rare or endangered habitat-types are scattered throughout areas subjected to high anthropogenic pressures through unsustainable activities, it must be ensured some form of `contact' between the different ecological sites occurs. In the case of protected animal and plant communities, it is widely acknowledged that species preserved in isolation in scattered conservation areas may eventually die out from lack of genetic diversity needed to maintain strong populations.

In an effort to allow ecosystems to adapt to changes, the planner, in planning conservation coastal areas programmes should seek the design biodiversity corridors to connect the various habitats so as to preserve natural genetic dispersal. To ensure that biodiversity corridors are respected, it is not enough to delineate their boundaries and embark on a buffer zone management programme, it is imperative that the cooperation of local resource users is sought.

In the end, conservation area system plans should be the product of informed consensus among all interested parties. *Concurrently, any plan should seek to balance the requirements of society with a level well below the carrying capacity of the environment.*

THE NEED FOR INTEGRATED COASTAL ZONE MANAGEMENT AND INDICATORS OF SUSTAINABILITY FOR THE MEDITERRANEAN COAST

Ms Ilkden Talay, Sukran Sahin; University of Ankara.

ABSTRACT

This paper is concerned with the need for Integrated Coastal Zone Management (ICZM) in the Mediterranean coast, supported by simple yet reliable indicators of sustainability with which to determine whether, or the extent to which, the expected benefits of ICZM are being realized.

Given the unrelenting pressure of a growing population and diverse activities, especially mass tourism, the environmental integrity of the Mediterranean coast and its ecosystems is under greater threat now than at any time before. It is argued that the adoption and implementation of ICZM is probably the only means by which this deteriorating trend could be arrested or reversed. It is argued, furthermore, that urgent efforts should be made to develop simple yet reliable indicators of sustainability to determine whether, following the implementation of ICZM, the situation is becoming more or less sustainable. It is also argued that there must be political will on the part of the relevant authorities to implement and enforce effective planning laws for coastal zones within the overall framework of ICZM, and that without this the coastal zones have a doubtful long-term future.

Keywords: Integrated Coastal Zone Management; environmental degradation; sustainable development; indicators of sustainability.

1. INTRODUCTION

Coastal environments are some of the most productive and diverse natural areas on earth, supporting a remarkable variety of habitats that have evolved over geological time as a result of changes in the sea level, and the influence of exposure to waves and currents, latitude, tidal range, and geology. The coast is a dynamic environment. And the way it is used also changes with new activities and pressures developing alongside more traditional uses of coastal land and inshore waters. Tourism is a recent and rapidly growing trend with an increasingly detrimental impact on the environment. Indeed, it is now the greatest growth industry on the Mediterranean coast where coastal locations are among the most popular destinations for tourists. As an example, in Greece 90 percent of the tourist investment is directed to the coast, while in Portugal the population density on the coast increases by more than 300 percent during the tourist season (CEC, 1994).

Historically, coasts have been of major economic importance, with cities developing where maritime trade routes made their landfall and where easy access to fisheries could provide food and create wealth for the nearby communities. Today coasts attract industry, tourism, trade and other activities, as well as housing for a large and growing population. Indeed, urbanization, population growth, industry and especially tourism today are at the root of many coastal problems. This is particularly noticeable in the Mediterranean where the population living in the coastal areas is predicted to reach more than 200 million by the year 2025 (Grenon and Batisse, 1989). This is far in excess of the carrying capacity of the Mediterranean coast, and its impact on both the coastal environment and ecosystems is not difficult to imagine.

Thus the problem of preserving the integrity of the Mediterranean coastal environments and ecosystems is one of growing concern, given the mounting detrimental impacts of diverse human activities and numbers. Notwithstanding some exceptions where remedial actions and policies are beginning to show signs of improvement, in general the situation continues to deteriorate. It is especially worrying to note that, despite numerous initiatives and expenditure of large amounts of money, not much of substance is happening to alleviate the relentless pressure of human numbers and activities on the coasts. To the contrary in fact — the problems are becoming increasingly more serious to threaten the integrity of coastal environments and ecosystems; this, in turn, diminishes or even destroys the natural resources (such as fish stocks, water quality, etc.) on which the coastal communities depend for their livelihood. Clearly, this state of affairs does not augur well for the future.

2. THE PROBLEM IN CONTEXT AND THE PURPOSE OF THIS PAPER

With regard to what we have said above, the major problems threatening the environmental integrity of the Mediterranean coast and its ecosystems are:

(a) *Industrial pollution:* Many of the factories and industrial enterprises discharge their partially treated or even untreated effluents into the coastal waters. In many cases industries can often reduce their production and/or transportation costs significantly by locating on the coast rather than inshore. Industrial pollutants, especially toxic chemicals, heavy metals, and chemicals with hormone-mimicking properties (such as nonyl phenols) have serious and sometimes irreversible impacts on coastal ecosystems. Many of the discharged chemicals react with chemicals already present in the coastal (inshore and foreshore) waters to produce secondary chemicals. The potential or manifest impacts of these secondary chemicals is also a cause for concern, because often it is difficult or even impossible to know what they are let alone define a standard for them. The hormone-mimicking chemicals, which have far reaching implications for reproduction, are a typical example of secondary chemicals

(b) *Domestic sewage:* Many of the coastal settlements, especially those on the eastern Mediterranean, discharge partially treated or even untreated domestic sewage into coastal waters. Chemicals and nutrients from domestic sewage can have a serious impact on coastal ecosystems. Of particular concern is the high level of E. coli bacteria (*Escherichia coli*) found in some coastal waters as a result of faecal pollution caused by the discharge of partially treated or untreated domestic sewage.

(c) *Construction on the coast or shoreline:* Construction of housing, infrastructure develop-ment, or the construction of tourist facilities on the coast or the shoreline has serious impacts on the coastal zone which can be degraded by erosion caused by such construction. Indeed, any human intervention on the shoreline has a detrimental effect on it, as will be seen from the following (Doyle et al., 1984):

- There is no erosion problem until a structure is built on the shoreline.
- Construction by man on the shoreline causes it to change (for the worse).
- Shoreline engineering protects property on the beach, not the beach itself.
- Shoreline engineering destroys the beach it was intended to save.
- The cost of saving beach property through shoreline engineering can often be greater than the value of the property to be saved. In other words, the benefit-cost ratio is less than unity.
- Once shoreline engineering begins, it cannot be stopped.

Clearly, the primary impact of (a) and (b) above is to diminish the quality of coastal waters and to make it harmful (potentially or manifestly) to human health, in addition to degrading the coastal ecosystems. The primary impact of (c) is generally to degrade the coastal environment through erosion and the various detrimental effects, especially of mass tourism.

With regard to the continuing degradation of the Mediterranean coastal environment and its ecosystems, our purpose in this paper is to draw attention to the relatively new management system, called the Integrated Coastal Zone Management (ICZM), which is now being advocated and adopted to address the environmental problems of coastal zones (Gubbay, 1998; World Bank, 1993; UNEP, 1995). According to many experts it is only through ICZM that the serious and growing coastal problems could be addressed in a strategic and holistic fashion.

Although the evolving theory of ICZM is known and documented, its implementation in many countries on the Mediterranean coast at present falls far short of what is urgently needed. This is due mainly to lack of both knowledge and political will. It is argued that both these deficiencies need to be addressed as a matter of priority, thus facilitating the effective implementation of ICZM. It is also argued that appropriate, simple and reliable indicators of sustainability need to be developed for measuring the effects of ICZM programmes. Because, it is only with such measurements that we could tell whether the situation is improving (becoming sustainable) or deteriorating (becoming unsustainable). Some ideas on how such indicators could be developed are also presented.

3. INTEGRATED COASTAL ZONE MANAGEMENT (ICZM)

A "Coastal Zone" is defined as a zone, which includes maritime land as well as foreshore and inshore waters. Thus Integrated Coastal Zone Management (ICZM) means the integrated (combined) management of maritime land as well as both foreshore and inshore waters. But the combination of maritime land and foreshore and inshore waters creates unique planning and management problems. Because, elements of both marine and terrestrial systems must be considered in planning and management, and at present there are few, if any, arrangements linking the terrestrial provisions with the marine provisions. It is for this reason that ICZM should have policies and programmes that are specific to the coast; but, at the same time, the policies and programmes must also address coastal problems through planning arrangements that might apply to the wider region or the country as a whole. Thus ICZM is essentially strategic in character, as is should be, given the known and unknown interactions which occur between the marine and terrestrial environments of a coast.

In general, ICZM programmes take into account the whole range of activity in the coastal zone and are concerned with both planning and management. A useful aspect of ICZM is that it provides an overview of such programmes, thus facilitating a better integration of the plans, policies and management arrangements within a strategic framework.

The key aspects of ICZM are the following (Gubbay, 1998; UNEP, 1995).

(a) The aims of ICZM are: (i) to promote sustainable use of marine and terrestrial resources; (ii) to achieve a balance between demands for coastal zone resources; (iii) resolve conflicts of use; (iv) to promote environmentally sensitive use of coastal zones; and (v) to promote strategic planning and management.

(b) ICZM recognizes: (i) that the coastal zone is an integrated unit for planning purposes; (ii) that planning and management of coastal land and waters cannot be dealt with separately; and that (iii) the coastal zone is an area which requires special attention for planning and management.

(c) ICZM requires: (i) a national perspective; (ii) a long-term view; (iii) an integrated approach to planning and management; (iii) communication, collaboration and coordination between planners, managers and users; (iv) public involvement; (v) a flexible approach; (vi) a specific agency to deal with matters relating to coastal zones.

4. IMPLEMENTATION OF ICZM

Although relatively new and still evolving, ICZM is rapidly gaining in popularity in the sense that it is now being implemented in an increasing number of countries worldwide. There are, however, different reasons why different countries choose to adopt ICZM. An analysis shows that while the developed countries adopt ICZM mainly to control both pollution and damage to ecosystems, and for deriving economic benefits from the coast and the ocean, the developing countries do so mainly to conserve resources, to control pollution, to derive economic benefits from the coast and the ocean, and for creating economic opportunities in the coastal zones (Gubbay, 1998). Whatever the motivation for choosing ICZM, it is clear that its adoption and effective implementation goes a long way to promote sustainable use of coastal zones for human welfare and economic benefits in a strategic and holistic fashion.

It will be observed, however, that the adoption of ICZM as a strategic management tool is one thing, and its effective implementation is quite another. ICZM would certainly not bear the expected fruits, unless it is effectively implemented. In this context implementation means execution of the planned programme aiming at sustainability, and periodic measurements with appropriate indicators of sustainability to determine whether the planned objectives (in accordance with the programme) are being realized in a sustainable manner. We will discuss indicators of sustainability in section 4.4.

We will outline below the key elements in the implementation of ICZM. Greater details will be found in (World Bank, 1993; UNEP, 1995) among others.

4.1 Definition of the coastal zone

To begin with, what constitutes a given coastal zone must be defined. However, there is at present no unique or universal definition of a coastal zone, except that it includes some coastal land, the foreshore water, and an area of inshore water (HMSO, 1992). A practical difficulty, which often arises, is this: whether a given coastal zone should be defined on the basis of environmental considerations, or on the basis of administrative and practical arrangements. Usually the outcome is some combination of the two. Experience shows that the early stages of an ICZM are dominated by discussions on the definition of a given coastal zone and its boundary; also that a flexible definition may be an advantage in some cases. But the precise definition of a given coastal zone, as well as a precise setting of its boundary, is essential, especially if the ICZM programme is to be enshrined in law.

4.2 Legislative backing

The management of coastal zones, regardless of whether ICZM or any other management system is adopted, inevitably involves some legislation. In general the laws tend to target specific stakeholders such as hotel owners, owners of other real estates, service providers, etc. The laws may focus on specific activities taking place in the coastal zone, or they may apply widely throughout the community at large. It is thus necessary to review existing laws to determine whether or not they need to be revised or reinforced for ICZM, or whether there is need for further legislation. From practical considerations it makes much sense to bring together all statutory ICZM controls and laws under a single and all-embracing piece of legislation.

In formulating legislative backing, due consideration must be given to the practical issues of compliance and enforcement. Far too often controls, laws and regulations become ineffective, as experience shows, either because they cannot be enforced, or because they are difficult to understand by those for whom they are meant.

4.3 Formulating and implementing an ICZM programme

An ICZM programme is essentially a 'plan of action' for achieving the 5 aims listed under (a) in section 3, within an over-arching and strategic framework of sustainable development. Indeed, sustainability is the central point of ICZM. Following democratic principles, all the stakeholders should be invited to make their inputs to the formulation of the ICZM programme and to participate in the decision-making process. Usually an ICZM programme produces a set of policies to be implemented hopefully to achieve a number of predetermined goals. This process involves four distinct steps (Nath, 1998).

In the first step the community at large, and the immediate stakeholders in particular, are informed about the need for adopting ICZM, how it works in practice, the expected benefits it would bring, etc. An explanation of why ICZM is being chosen in preference to other management systems, and the existing system in particular, should also be given. The policies for the proposed ICZM programme are then explained with a view to obtaining their acceptance by the community at large, including the immediate stakeholders. The policies may have to be revised subsequently, or new policies adopted, in response to public demand or expectation.

In the second step the policies are developed, and the costs and benefits of the policy package are calculated as accurately and realistically as possible in money terms. While the costs are usually relatively straightforward to calculate, the benefits are not. This is because the benefits are often in terms of social welfare or environmental benefits such as 'improved environment', 'cleaner air', and so on (how do you calculate the value of cleaner air in money terms?). These are non-market goods whose values can only be determined in terms of 'shadow prices' using the methods of econometrics such as the Contingent Valuation Method (CVM), the Hedonic Pricing Approach (HPA), the Travel Method (TM), etc. The central point here is that, in money terms, the expected benefits of the proposed policies (and therefore of the ICZM programme) must be greater than their costs.

In the third step the community at large, and the immediate stakeholders in particular, is invited to scrutinize the developed policies. The purpose here is to verify their acceptance (or otherwise) of the developed policies. Some revision of the policies may be necessary to address public concern or expectation.

In the fourth and final step, the policies are implemented with appropriate legislative controls and backing, and with necessary machinery to ensure compliance and enforcement. It is also important to monitor the performance of the policies to see whether or not they are working as intended. Indicators of sustainability (section 4.4) may be used to measure the performance of the policies. Clearly, the policies would need to be revised or replaced, if they are found not to be working as intended.

The need for, and the importance of, public involvement in formulating and implementing an ICZM programme cannot be over-stressed. The methodology for this, following the 'bottom-up' approach, is clearly explained in Agenda 21, and especially in Local Agenda 21 (Grubb et al., 1993; Hens, 1996).

4.4 Indicators of sustainability

It is important, especially for policy-makers, to know whether or the extent to which the implemented policies are working as expected. If they are found to be working, it means that at least some degree of sustainability is also being achieved. Because, as we have pointed out earlier, the focus of ICZM is sustainability. Therefore, a successful ICZM policy automatically means the achievement of some degree of sustainability. It is to be noted, however, that whether or not a target problem or activity is making progress towards sustainability can only be measured with one or more suitable indicators of sustainability.

An 'indicator of sustainability' is a management tool, which is used to obtain an indication of whether or not a target problem or activity is becoming sustainable over time. Indicators of sustainability can be of different types such as social indicators, economic indicators, environmental indicators etc., but in some cases the distinction may not be sharp.

A successful indicator of sustainability should have the following characteristics (Nath and Vivian, 1998):

(i) it should focus on the status of a significant and fundamental target problem or activity.

(ii) it should be well understood and accepted by the community at large.

(iii) It should enable the quantitative measurement of the target problem or activity for which it is designed.

(iv) it should represent, or directly relate to, important quality of life issues and values of the community.

(v) it should be user-driven, policy-relevant and highly aggregated.

(vi) it should be simple to understand and easy to use.

Items (a), (b) and (c) in section 2 are often the focus of ICZM policies in the sense that these policies are mainly designed to address the issues of those items. However, the development of simple but reliable indicators to show whether the problems of (a), (b) and (c) are increasing or diminishing is complicated mainly by the fact that a coastal zone consists of a terrestrial element as well as a marine element, as we have already pointed out, and the characteristics of the two elements as well as their planning and management regimes are different. In view of this, and given the urgency of the problem, an empirical or even commonsensical approach would be better now than none at all. Hopefully some day in future more robust and comprehensive indicators would be available for the job. It is pointed out, however, that several attempts have been made by researchers so far to develop reliable indicators of sustainability for coastal areas. But they have inherent problems, are too complicated to use, or require extensive monitoring and/or historical data.

For items (a) and (b), section 2, water quality indicators may be used. But, given that there are inshore and foreshore waters, it would be prudent to develop two different sets of indicator, one for inshore water and the other for foreshore water. In each case the quality of water may be sampled at a number of strategic locations on a daily basis, and the measured quality compared with the key parameters of the EU bathing water quality. The differences can be expressed as non-dimensional ratios, whose calculated values over time would show whether or not the problems of items (a) and (b) (section 2) are increasing or diminishing. If the ratios show a decreasing trend, then this would clearly indicate that the problems caused by the discharge of industrial effluents and domestic sewage are diminishing; in other words, the situation is becoming sustainable. Regular E coli count at strategic locations should also be undertaken within the context of bathing water quality. The difference between the measured counts and the maximum permitted by the EU bathing water quality directive, expressed as non-dimensional ratios, would indicate the safety of both inshore and foreshore waters. The same can also be done, if necessary, for BOD or any other locally relevant or important contaminant.

The above obviously lacks the sophistication of indicators developed with time-series analysis and the like. But, as we have said earlier, simple and easily understood indicators such as these now are better than none at all. The fact remains that at present in many cases no indicators are used, especially in the eastern Mediterranean. If they are, it is done in a *laissez-faire* fashion, often without proper understanding or application.

With regard to item (c), section 2, strategic planning for the construction of buildings, infra-structure and facilities in the coastal zone, giving due consideration to environmental protection, is the key to maintaining its environmental integrity. This is critically important because, as pointed out in (c) (section 2), strictly speaking no development should be permitted in the coastal zone if we are serious about preserving its physical and environmental integrity.

Yet, in may countries on the Mediterranean coast, especially in eastern Mediterranean, planning laws and regulations for the coastal zones are conspicuous either by their absence, or by the absence of their enforcement. Turkey is a typical example, as any informed visitor to that country's coastal resorts would readily confirm. The crucial trigger here is the political will of the relevant authorities not only to formulate and implement essential planning laws, but also to ensure their enforcement and compliance. The main reason for the absence of planning laws and/or their lax enforcement is economic, reflecting a trade-off between income generation and environmental degradation. However, in the absence of strict planning regulations and/or their effective enforcement, it is doubtful whether the coastal zones of those countries could ever aspire to a viable long-term future.

The development of simple yet reliable indicators of sustainability for item (c), section 2, poses some problems. This is because different types of construction on the coast has different levels of impact, depending on the quantity and quality of their emissions, distance from the shoreline, usage, communication (transportation pathways), etc. The impact of a hotel on the beach front, for example, is quite different from that of a production facility located inshore, even when both occupy equal land areas. But, since the polluting discharges of both will have been accounted for in items (a) and (b) of section 2, their remaining impacts purely in terms of their land degradation and erosion potential may be expressed by means of a separate indicator. Then, notwithstanding this simplification, a simple indicator may be expressed as the ratio: (total new construction in square metres each year)/(total new and old construction in square metres in the preceding year). Ideally this ratio should be zero; that is, no new net construction should be permitted. Despite its lack of sophistication, an indicator such as this would be helpful to the decision-makers.

4.5 Monitoring with indicators of sustainability

Once an indicator of sustainability (having the characteristics mentioned in section 4.4) has been developed, the next step is to use it to monitor the target problem or activity. In this context 'monitoring' means keeping the target problem of activity under observation, with periodic measurement using the indicator of sustainability as a 'yardstick'. The purpose is to determine whether the target problem or activity is becoming sustainable (improving) or unsustainable (deteriorating) over time, or if there is no change as a result of the implemented policies (Nath, 1998).

The frequency of measurement would depend on the target problem or activity itself. While daily measurement would be recommended for the quality of water sampled at a number of strategic locations, annual measurement would be recommended for the total new construction in square meters.

There must also be an appropriate time-scale for evaluating the measurements made with an indicator. In case of an indicator for measuring the concentration of a specific chemical, for example, it may be necessary to consider the residence time of the chemical in the environment. In some cases it may take many years of monitoring to determine whether the impact of the target problem or activity is increasing or decreasing over time.

Data generated from periodic measurements should be stored for future use. Also, often historical data are needed for monitoring with indicators of sustainability. But, sometimes historical data may not be available, or unreliable if available. Thus, monitoring with indicators of sustainable relies not only on the availability of current and sometimes historical data, but also on the quality and reliability of such data.

4.6 Interactions, linkages and aggregation of sustainability indicators

Often there are 'interactions' and 'linkages' between different types of sustainability indicators that can be difficult to assess or quantify. Such interactions and linkages can occur between different types of indicators and also between different indicators of the same type. But the problem is that, the strength of these interactions and linkages is difficult to quantify.

These interactions and linkages between and among indicators need to be understood. A great deal of work remains to be done for understanding these interactions and linkages, and it is only with such understanding that related social, economic and environmental indicators could be aggregated to produce a reliable compound indicator of sustainability similar to the GDP (Gross Domestic Product) which is used extensively and reliably in macroeconomics.

At the international level, only a limited number of compound (aggregated) indices have so far been developed, including UNDP's Human Development Index (HDI), and works of the Com-mission of the European Communities and the Asian Development Bank.

5. CONCLUDING REMARKS

Given the continuing environmental deterioration of the Mediterranean coast and its ecosystems, especially on the eastern Mediterranean coast, there is now urgent need for the effective implementation of a management system which aims at sustainability, and, at the same time, is strategic in its approach. The Integrated Coastal Zone Management (ICZM) is such a management system. Its urgent and effective implementation is strongly recommended. Also recommended is the development of simple indicators of sustainability, that are easy to understand and apply, with which the expected benefits of ICZM could be measured to determine whether, or the extent to which, sustainability in at least the key areas of human activities in the coastal zone is being realized.

Developing indicators of sustainability, and using them for monitoring, is a long-term commit-ment and there are major problems facing most of the countries in this regard

— especially developing countries. Large amounts of data are needed for development and monitoring. Availability and reliability of data is thus a basic requirement for both developing indicators of sustainability and using them for monitoring.

Clearly, development of efficient procedures for gathering reliable data is essential for project development, management, and monitoring in order to achieve sustainability targets. In the national context, this means that all national government departments should coordinate their efforts efficiently to support data collection, to disseminate information, and to be involved in the development of indicators of sustainability. The role of effective coordination and consultation at this stage cannot be over-stated.

Given that the jurisdiction of many environmental problems is also regional and even global, development of indicators of sustainability sometimes involves extensive coordination and consultation at the regional or international level, too. At present there is no unique operational definition of sustainability, which is universally accepted. Consequently, it difficulty to develop a common yardstick (indicator of sustainability) which could be used in different countries or in different geo-political regions. This aspect alone highlight the urgent need for cooperation and consultation at both regional and international levels.

The development of Indicators of sustainability can be an important catalyst in the debate on major issues of sustainable development, thus creating an effective forum for the debate and discussion of relevant issues and problems, in which NGOs and other interested parties could participate, share information and interact. A useful spin-off of this would be wide dissemination of information and raised awareness of the pertinent issues and problems. It is pointed out, however, that developing indicators and making impressive publications on them is certainly not enough, neither is it the objective. What is urgently needed is the practical application of the indicators to address the serious and growing quality of life problems that are thwarting human development especially in the developing countries. Both municipalities and local governments have an important role to play in this.

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INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20 November 1998; Izmir-Turkey

PROCESS SIMULATION AS A TOOL FOR EVALUATING ENVIRONMENTAL IMPACT

A. Bertucco, Istituto di Impianti Chimici, University of Padova.

Agenda

- General statements and strategy
- Main features of an environmental policy
- Pollution prevention techniques and Process simulation
- Applications and examples

The general context and motivations

- Pollution Prevention in the Chemical Industry
  - Increasing cost of waste disposal
  - Growing number of environmental regulations
- Environmental policy as an integral component of the corporate strategy

Environmental concern and wastes

- Waste minimization at their source leads to ...
  - cost savings
  - improved product yield and quality
  - reduced pollution
  - safer workplace conditions
  - fewer waste management needs
  - conservation of natural resources
- Waste treatment is often needed
- End-of-pipe approaches are more expensive but still necessary

Features of an environmental Policy ...

- Leadership
  - Combination of plant manager and health officer
  - Responsibility of setting goals for reduction in generation of specific chemical wastes

- Material Balance, which aims at accounting for every quantity of a chemical that is:
  - shipped to the process
  - created or destroyed in the process
  - delivered as a product from the process
  - released as gaseous, liquid, or solid waste

... Features of an environmental Policy

- Cost accounting, which assigns the pollution cost to individual process, such as:
  - pollution control
  - waste disposal
  - regulatory compliance
  - lost materials
  - insurance
  - future liabilities
  - public and customer relations dealing with waste issues
- Employee involvement at all levels
  - from top manager to production and maintenence workers
  - workers need training

Pollution prevention techniques

- Process changes
- Operation changes
- Equipment changes
- Chemical substitution
- Product substitution

Pollution prevention: Operation changes

- involve improving plant operations
  - material handling and equipment maintenance
  - better control of material use
  - employee practices
- to minimize
  - spills
  - process upsets
  - excessive use of chemicals
  - or other problems that can generate wastes
- in every stage of the process
  - storing

- moving
- mixing
- reacting chemicals

Pollution prevention: other techniques

- Equipment changes
- Chemical substitutions
  - involve using raw materials that create fewer toxic and hazardous wastes during production process without necessarily changing the process itself
  - aiming at substituting hazardous and toxic materials
- Product changes
  - involve designing the end product so its manufacture creates less toxic and hazardous waste
  - can be achieved without changing the fundamental manufacturing process (ex. : pellets rather than powder)

Benefit of Process Simulation

- The modeling of a chemical process enables to efficiently analyze the process in terms of environmental impact
- Modeling plays an integral role in company's environmental policy

Results in terms of environmental impact

- Compute the operating conditions to meet the discharge requirement
- Compute the performance, capital and operating costs for each equipment item
- Compute the properties of materials in a waste treatment process
- Prepare an integrated flowsheet that considers design constraints
- Automatically maximize performances, within process constraints
- Fit the parameters of the waste treatment models to experimental data
- Perform sensitivity calculations

Results in terms of modeling as a general rule

- Complete material balance
- Identification of the costs and savings potential of pollution prevention options
- Effective vehicle of communication among managers, engineers, and production workers to describe the impact of making processes, operations or equipment changes
- What if scenarios can be evaluated
- Model allows accurate support of pilot plant tests
- Process simulation helps the engineer in deep understanding of process design and in evaluating process alternatives
- The waste treatment process can be optimized to identify the operating conditions that achieve the most effective and economic treatment within regulatory constraints

SOME EXAMPLES AND APPLICATIONS

Coke oven gas desulfurization

- Goal:
  - lower the hydrogen sulfide content of purified coke oven gas from coke plant
- Simulation
  - identify ways of optimize process parameters to lower sulfur content
  - identification of new process conditions
- Results
  - decrease of sulfur dioxide emissions of 360 tons per year
  - 30% of the sulfur dioxide emissions reduction

Defining process conditions of a sour water stripping system

- Goal
  - a Chinese Design Institute was contracted to design a high sulfur sour water treatment process within a very tight timeframe
- Simulation
  - electrolyte containing complex system
  - evaluation of different process schemes
- Results
  - process conditions and sensitivities of key process variables were defined with only two person-months effort

Improving the operations of a Waste water treatment plant

- Goal
  - debottleneck the plant and determine how operating variables can be manipulated to improve efluent quality
- Simulation
  - identification of the clarifier as the bottelneck unit
- Results
  - additional capacity and operating changes in the clarifier can improve the capacity of the plant
  - evaluation of the impact of the plant loading on the effluent quality
  - study alternative operating tecniques (changing residence time, recycle, level of biomass) to lessen toxicity

Evaluating alternative process configurations to meet environmental regulations

- Goal
  - a dye producer applies single stage reverse osmosis to purify effluents
  - new modules are to be added to meet regulations
- Simulation
  - simulation of all possible new configurations (six months work estimation in a pilot plant)
  - comparison in terms of process economy and performances
- Results
  - optimum design found in two weeks
  - savings of 5 months investments
  - environmental regulations were met on schedule

Identify the design of an industrial sludge incinerator

- Goal
  - design an incinerator for industrial sludge

- Simulation
  - identify optimum design with the minimum heavy oil addition as a function of sludge humidity
- Results
  - optimal design which saved 30% in heavy oil consumption over previous design was identified

Optimizing steam consumption for solvent recovery

- Goal
  - recovery of methylene chloride from waste
- Simulation
  - calculation of the steam consumption
  - identification of the optimum conditions
- Results
  - savings in steam usage realized without any major process or equipment changes

Process simulation is a simple and helpful tool that may help in solving problems connected to the environmental impact

Process Simulation as a Tool for Evaluating Environmental Impact

2. Overview on Process Simulators

Agenda

- Process simulation goals and definitions
- The use of process simulation in industry
- The software structure of a process simulator
- The procedure and the results obtainable
- The user interface and the interoperability
- The hardware - operating systems solutions

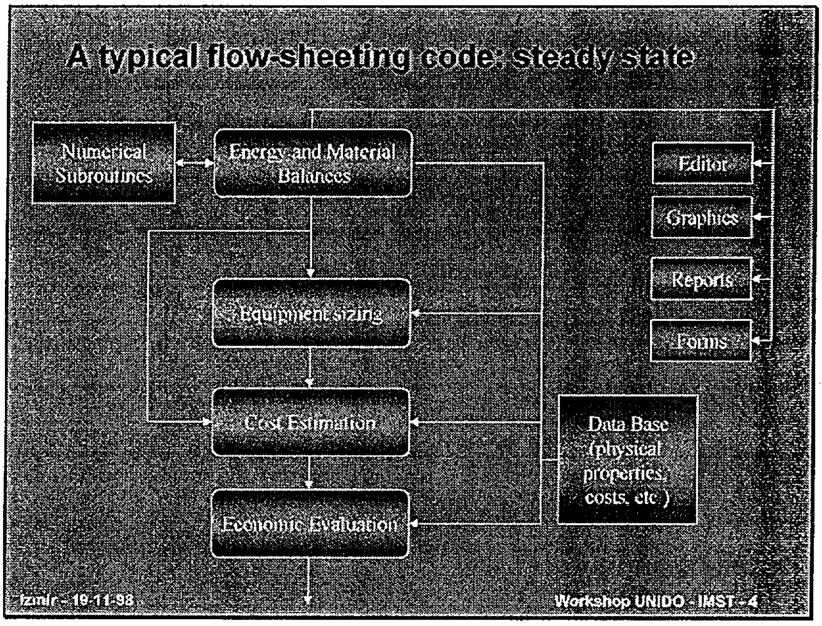
Solving Material and Energy Balances using Flowsheeting Codes

Flowsheeting:

steady state process material and energy balances

Flowsheeting Package or Code:

the computer code



Mathematically speaking

- *n* non linear material balances equations
- *1* energy balance non linear equation
- set of differential - algebraic equations (dynamic simulators)
- In the presence of:
- Very many components;
- Complex thermo-physical models for phase equilibrium calculations
- A high number of subsystems (equipment)
- Rather complex equipment (distillation column,...)
- Recycle streams

- Control loops

The fundamentals

- Different possibilities for process simulation
- Steady state simulation
- Dynamic simulation
- Integrated steady state - dynamic simulation
- Different philosophy
- Process analysis
- Process synthesis
- Process simulation impact on industry
- The way engineering knowledge is used in processes
- The design procedure of the process (plant)
- The prediction of plant behavior under changed conditions

From a traditional way of using process simulation ...

1. Flow sheet design
2. Equipment critical parameters definition and check
   (e.g. distillation column stages, column diameter,...)

... to the comprehensive use of Process simulation in the entire 'life' of the plant

1. Design of control strategies
2. Process parameters optimization (--> 'better' processes)
3. Time evolution of the process (start up and shut down)
   (--> risk analysis)
4. Operator training
5. Definition of procedure to reduce unsteady state operations

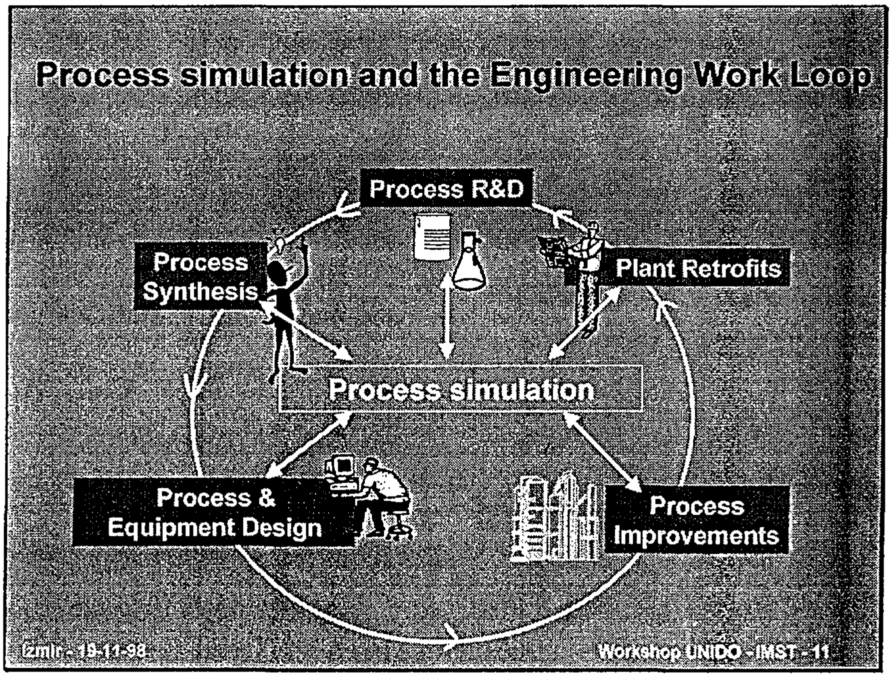
Benefits

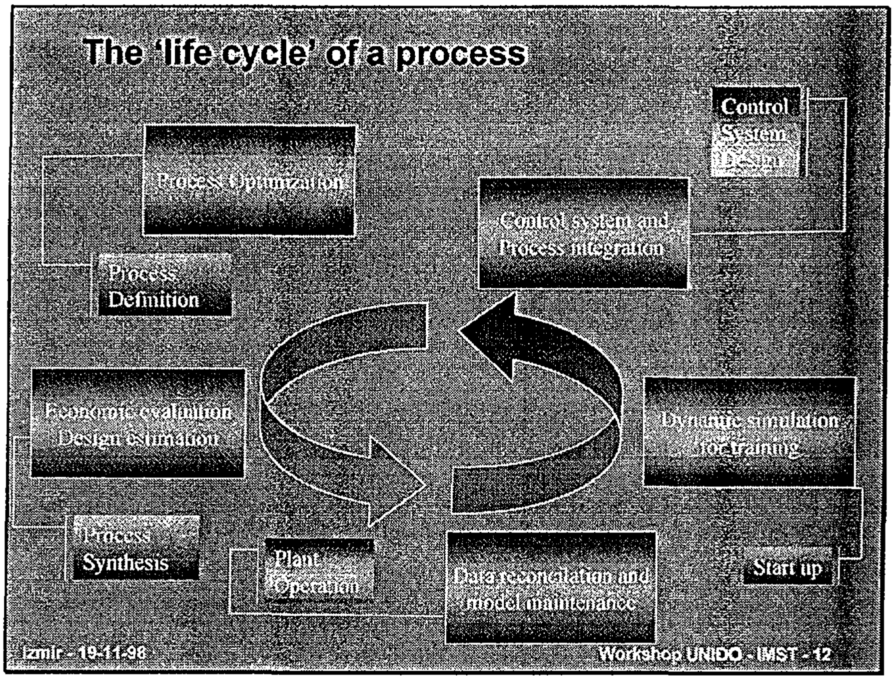
- Partial or total replacement of Pilot Plant operations
- Reduction of the number of runs
- Runs planning (experiment design)
- Reduction of time to market for the development of new processes
- Fast screening of process alternatives to select the best solution
- economic aspects
- environmental aspects
- energy consumption aspects
- flexibility of the proposed process

To get those benefits one must:

1. SIMPLIFY THE PROCESS CRITICALLY

2. SELECT LESS DANGEROUS COMPOUNDS TO MAKE THE SAME PRODUCTS





Numerical strategies

- Equation oriented strategy - simultaneous solution
  - Write down the entire set of equation
  - Identify the constraints
  - Solve the non linear system
- Sequential Modular approach
  - Each subsystem is solved independently, starting from the first one
  - Output streams for the solved subsystems are input streams for the next subsystem
  - Problems for the recycle streams (of material, energy and information)
- Combination of the two extreme approach
  - Equation can be lumped into modules
  - Modules can be represented by polynomials that fit input-output information

Equation oriented flow-sheeting ...

- Solution of a set of non linear equations with constraints
- Definition of the matrix of the stream connection (process matrix)
- Inequality constraints
  - Linearization of non-linear equations
  - Process limits for Temperature, Pressure, concentration
  - Requirements that variables be in a certain order
  - Requirements that variables be positive or integer
- Define the procedure for determining the order in solving the equations
- The treatment of feedback (recycles)

Equation oriented flow-sheeting

- Method of solution
  - Modified Newton Raphson (Broyden)
  - Multivariable Secant (Wegstein)

- Tearing = selecting certain output variables from a set of equations as known values so that the remaining variables can be solved by serial substitution
- Partitioning = dividing equations into blocks containing common variables
- Definition of initial guess
- Scaling of variables (the same order of magnitude)
- Scaling of equations (the same deviation from zero)

Sequential modular approach ...

- Most common approach
- Each unit operation is described by a subroutine (or DLL)
- Other subroutines take care of
- equipment sizing and cost estimation
- numerical calculations
- handling recycle calculations
- optimizing and serving as controllers for the whole set of modules
- Tearing and partitioning
- Fortran or C codes

Advantages and disadvantages of s.m.a.

- Advantages
- The flow-sheet architecture is easily understood because it closely follows the process
- Individual modules can easily be added and removed
- Modules of different levels of accuracy can be substituted
- Drawbacks
- The input of a module is the output of another module: you cannot arbitrarily introduce an output or input
- The modules need extra time to generate derivatives (perturbation of the input)
- The modules may require a fixed procedure for the order of solution: slow convergence
- Parameter specification is done with control loops: possibility of introducing nested loops
- Phase equilibrium instability during the convergence of the process

Steady state simulators: the core product

- Steady-state simulation for process design, evaluating process changes and analyzing what-if scenarios
- Basis for:
- dynamic simulation
- process synthesis with Pinch technology

- detailed equipment design
- off-line and on-line equation-based optimization
- application technologies for vertical markets, e.g. polymers

Process simulation: the procedure ...

- Identify the problem
- Obtain all the relevant information
- Get process data: operating conditions of flow rates
- Get thermodynamic data:
- *FROM IN HOUSE DATA*
- *FROM DATA BANKS (DECHEMA, ...) OR LITERATURE*
- *THROUGH TEST RUNS ON LABORATORY / PILOT PLANTS (BE SUSPICIOUS ON THE GROUP CONTRIBUTION METHODS)*
- Get kinetic data
- *DIRECTLY FROM LABORATORY / PILOT PLANT*
- *FROM EXCESS GIBBS ENERGY CALCULATIONS (IF POSSIBLE)*
- *DIRECTLY FROM PLANT DATA*
- TIP OF THE DAY: avoid a rigorous definition of the kinetic model and use concept of yield and conversion whenever possible and reasonable

... Process simulation: the procedure ...

- Select the software
- Steady state simulation
- *ASPENPLUS*
- *CHEMCAD III*
- *HYSIM*
- *PRO II*
- *...OTHERS*
- Dynamic simulation:
- *SPEEDUP - ASPEN CUSTOM MODEL*
- *HYSIS*
- *PROTISS*
- Integrated solution

- *ASPEN DYNAMIC*
- *HYSIS*
- Select the Hardware

... Process simulation: the procedure

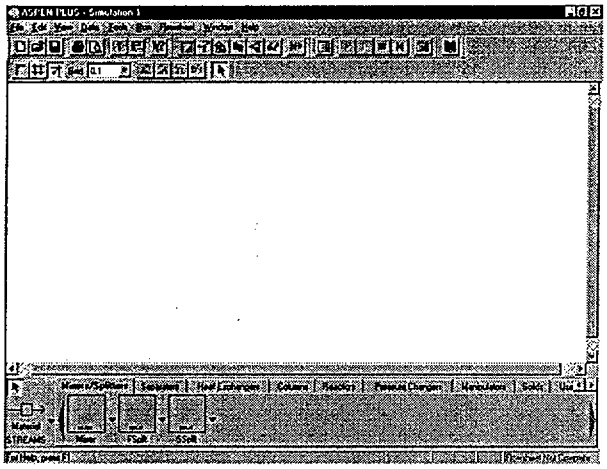
- Training
- Basic course on process simulation
- Thermodynamic model selection
- Specific topics
  (heat exchangers, batch, heat integration, cost analysis,...)
- Economic factors
- Energy consumption
- Environmental impact
- Operational procedure

Process simulation: the logic procedure

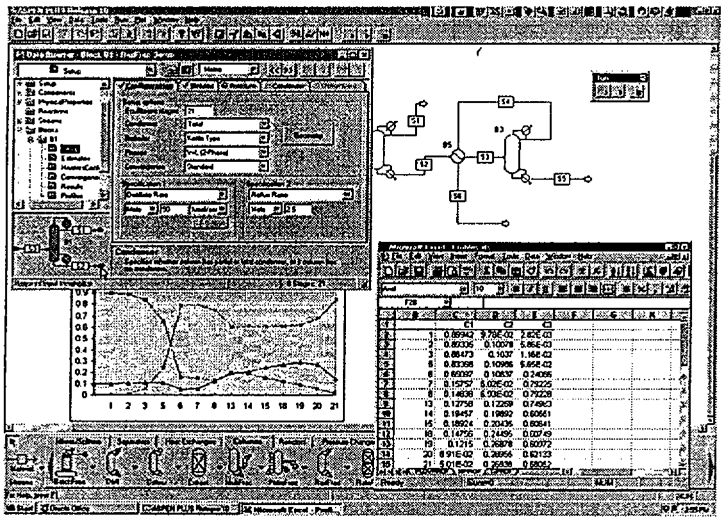
- Components definition
- Physical - Chemical properties selection
- Flow sheet connectivity
- Feed condition assignment
- Saturation of unit operation degrees of freedom
- Assignment of process specifications
- Definition of an objective function to minimise
- Control parameter definition
- Equipment Hold up assignment

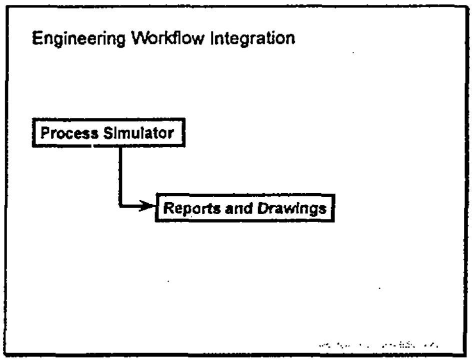
User interface and Interoperability

1. Graphical user interface
2. Engineering Workflow Integration
   Basic Windows interoperability
   Microsoft COM / OLE Automation (ActiveX) technology



ASPEN PLUS 10





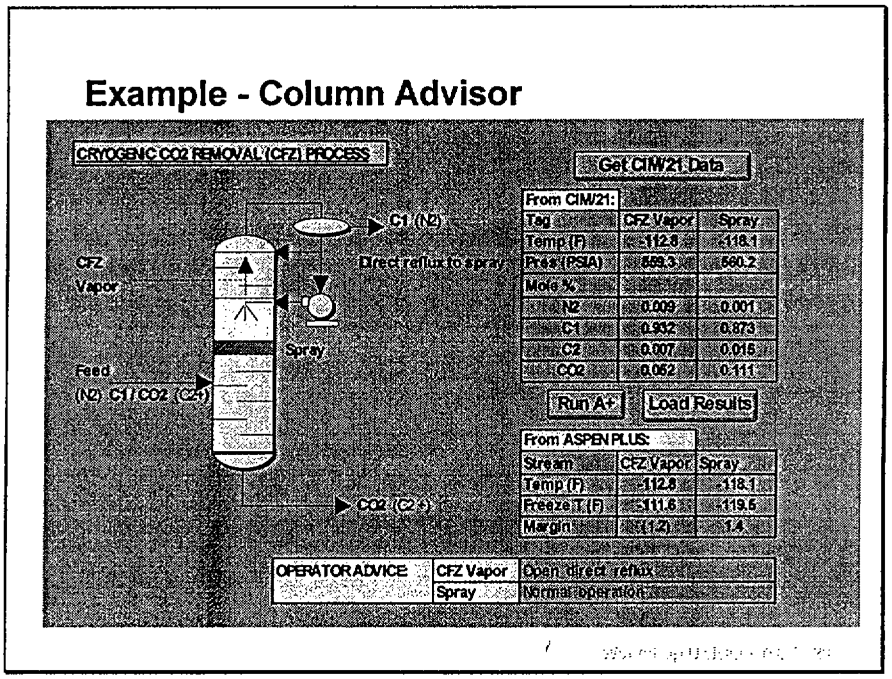
Windows Interoperability

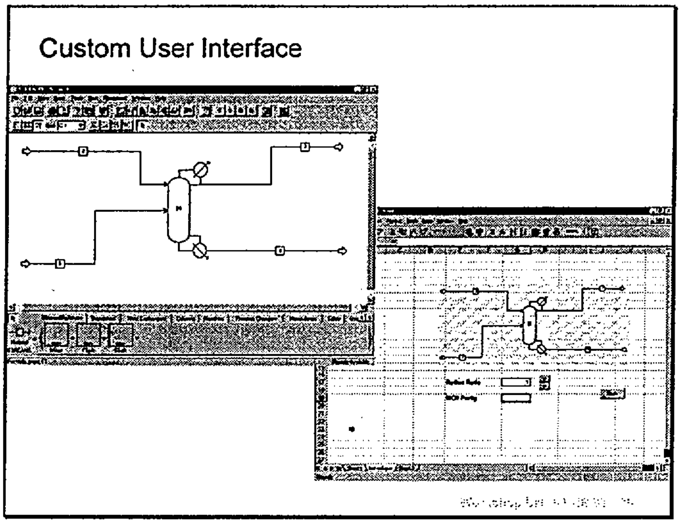
- Two-way data transfer between the software and other Windows applications via copy, paste, paste link
- Access to all inputs & results
- Access to plots and flowsheet graphics
- Copy data tables and spreadsheets into the simulator for DRS, Data-Fit, etc
- Windows Interoperability - Benefits
- Quick and error-free ad-hoc transfer of the simulator results to other Windows applications
- Easier preparation of reports and results

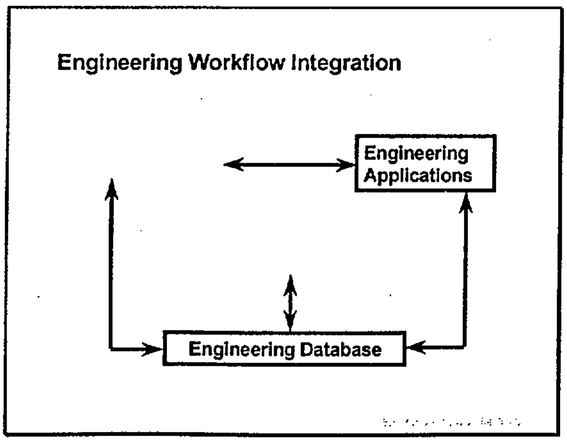
OLE Automation (ActiveX)

- OLE automation interface allows two-way access to:
- Simulation objects and data
- Simulation methods (file open, run, etc.)
- through Visual Basic or C++

- Supports development of end-user model interfaces

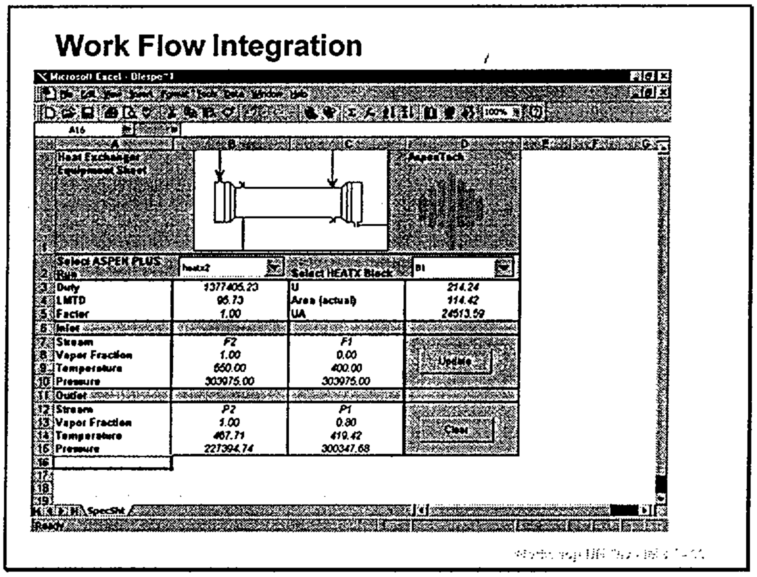






Workflow Integration

- Supported interfaces to specific 3rd-party engineering applications
- equipment design (B-JAC, HTRI, HTFS)
- engineering databases (Aspen Zyqad, PASCE)
- costing packages (ICARUS)
- in-house technologies
- Workflow Integration - Benefits
- Support for engineering infrastructures that integrate engineering work processes
- Error-free data transfer into 3rd party Windows engineering programs
- Quick and consistent use of simulation results throughout the engineering lifecycle
- Improved engineering quality



The Hardware and Operating systems

- Operating Systems
- Client - server solutions
- Client is Windows NT 4.0 and 5.0 (late 1999)
- Server is Windows NT or UNIX
- Office environment
- Hardware
- Client: PC Intel Pentium II 400Mhz - 32-64 MB RAM - SCSI Disks 8 GB - High quality monitor and video board
- Server: Intel or RISC based systems - 512 MB RAM - SCSI RAID Disks, BU unit, ...

Process Simulation: results obtainable

- Validation of phase equilibria models for the real system to be used in similar conditions
- Verification of process operating conditions
- Information on intermediate streams (not measured)
- Energy consumption information
- Check of the achieved plant specifications
- Influence of operating parameters on process specifications (sensitivity analysis)
- Process de-bottleneking for each individual section
- A priori identification of process control strategies and tuning of instrumentation
- Possibility to verify safety system behavior for variation of process conditions

Problems that may become relevant

- Definition of an accurate thermodynamic model (Equations of state)
- Availability of kinetic data
- Need of modeling unit operations not provided by the Process Simulator
- Tear streams identification to achieve rapid convergence

Applications of Dynamic Simulation

Continuous Processes

- Concurrent process and control design
- Evaluation of alternative control strategies
- Troubleshooting process operability
- Verification of process safety

Batch Processes

- Design of batch and semi-continuous processes

Online Applications

- Calculation of inferential measurements
- Identification for model-based control
- Decision support

Benefits of Dynamics Modeling

- Capital avoidance and lower operating costs through better engineering decisions
- Throughput, product quality, safety and environmental improvements through improved process understanding
- Increased productivity through enhanced integration of engineering work processes

Characteristics of a good Process Simulator

- *Flowsheet*: suitable graphic interfaces

- *Components*: large and accurate databases
- *Unit Operations*: reliable models
- *Streams*: any type (multiphase, solids, electrolytes...)
- *Properties*: up-to-date models
- *General*: user friendly (and fool proof)
- *Robustness*: high against user's mistakes
- *Convergence*: fast and safe to the correct solution
- *Accessories*: equipment design, economics, sensitivity analysis, optimisation
- *Flexibility*: linkable to user's routines

What a Process Simulator can and cannot do

- *Basic 1*: apply the degree-of-freedom analysis
- *Basic 2*: write & solve material+energy balances
- *Special*: sensitivity analysis and optimisation

HOWEVER

- no equipment design nor momentum balances
- models of some important units missing
- convergence not sufficient for meaningful results
- a Process Simulator is a tool: it cannot interpret results

Potentials of Process Simulation in the Chemical Industry

- Representing correctly plant operations
- Developing the process (revamping, upgrading,...)
- *Advanced*: operator training (regular and safety)
- *Advanced*: on-line process operation and control
- *Advanced:* development of alternative, environmentally friend processes

TIPS FOR A SUCCESSFUL SIMULATION:

- verify thermodynamic and kinetic data reliability
- select suitable property models and parameters
- calibrate simulation results on pilot plant runs

Cautions in using a Process Simulator: it is a nonsense ...

- *to run a Process Simulator without an accurate selection of the property models*
- *to select a good property model without knowing the value of its parameters*
- *to use predictive models anyway; one good experimental property datum is always better*

... and note that

- *The GIGO (garbage in gospel out) approach must be avoided*

■ *The best available model might not be the best choice*

In Summary we went through ...

- Process simulation goals and definitions
- The use of process simulation in industry
- The software structure of a process simulator
- The procedure and the results obtainable
- The user interface and the interoperability
- ***The hardware - operating systems solutions***

Process simulation is a simple and helpful tool...

... to be used by chemical engineers that fully understand the process

... Never let a kid play with a real gun.

Production of Propylene Oxide in a Reactive distillation column

Why a "reactive" distillation column?

1. *Production* of Propylene Oxide (PO) in a liquid alkaline phase (saponification)

2 CH3-CHOH-CH2Cl + Ca(OH)2 ⇔ 2 CH3-CHOCH2 + CaCl2 + 2 H2O

chlorhydrine Ca hydroxide PO Ca chloride

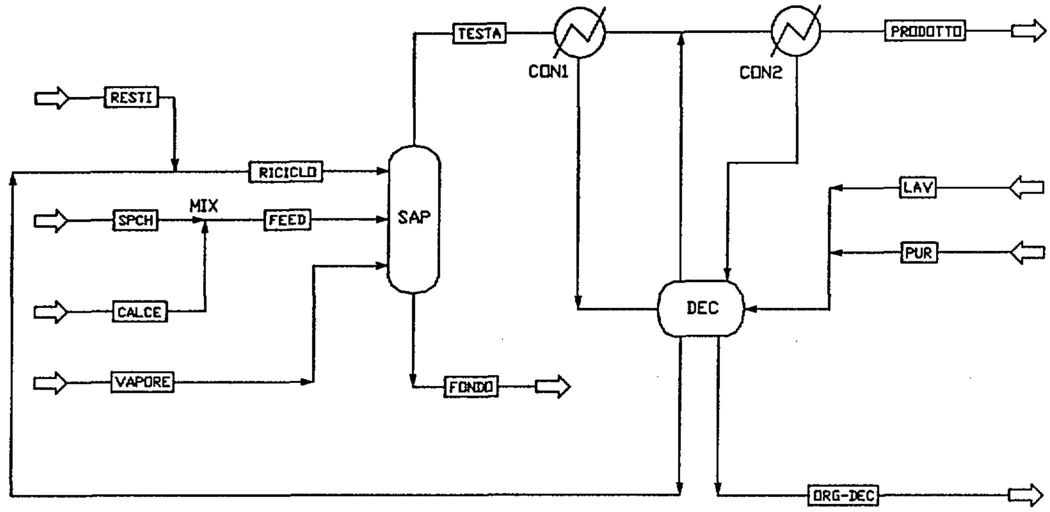
2. *Separation* of PO from the reactive solution

CH3-CHOCH2 + H2O ⇔ CH3-CHOH-CH2OH (*to avoid!*)

PO Propylene Glycol

In a "reactive " column both operations can be achieved simultaneously

The plant section considered



flowsheet modeled by Aspen Plus

Thermodynamics

- *Main* components:
    1. water (H2O)
    2. propylene chlorhydrine (PCH)
    3. propylene oxide (PO)
    4. dichloropropane (DCP)
    5. dichloro-*i*-propylether (DCIPE)
    6. propylene glycol (GLY)
    7. calcium chloride (CACL)
    8. calcium hydroxide (CAOH)

- Complex system, due to the presence of:
- *water*
- *organic compounds* of different polarity
- *electrolytes / salts*
- Electrolytes
- model by Chen *et al.* (1982; 1986), implemented through module ELECNRTL of Aspen Plus
- Non-electrolytes
- NRTL by Renon and Prausnitz (1968)
- *Salting-out* effect:
- the change in the activity coefficient is calculated as a function of the CaCl2 concentration, according to Carrà *et al.* (1979)

CHEMICAL KINETICS

- Model proposed by Carrà *et al.* (1979)

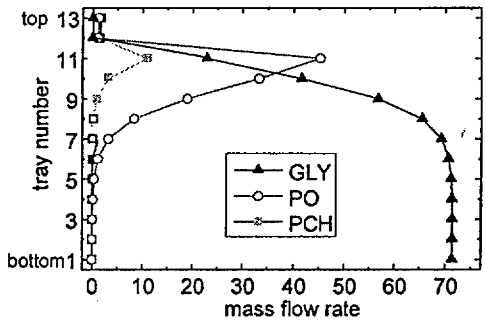
$r1 = k1$ [PCH] (PO production)

$r2 = (kh + koh$ [OH -]) [PO] (GLY production)

- Both reactions occur in the liquid phase
- The production of PO is much faster than the GLY formation
- High residence times lead to the formation of by-products

Column simulation

- **Internal liquid flow rates ("scaled" values)**



Below tray no. 5 the PO production is negligible

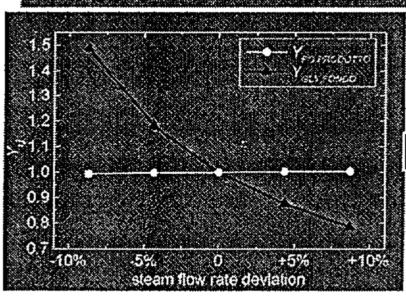
⇓

no GLY can be formed

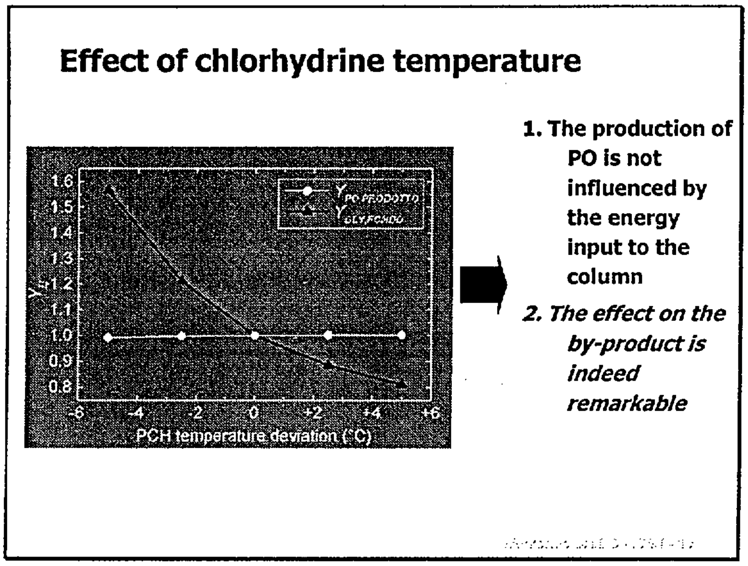
Effect of the stripping steam flow rate

- **Normalised production of *i* in the stream *j*:**

$$Y_{i,j} = \frac{(\text{portata del componente } i \text{ per kg di PCH fresca})}{(\text{portata del componente } i \text{ per kg di PCH fresca})}$$



The production of glycol *is strongly affected by the steam flow rate value*



Increasing the column capacity:

- In the base case (reference conditions), the column is operated around 50% of flooding; therefore, the feed flow rate can be increased

	portata alim. nom.	+ 20% aliment.	+ 40% aliment.	+50 % aliment.
% flooding	49	59	68	73
$Y_{PO,PRODOTTO}$	1	1.002	1.003	1.004
$Y_{GLY,FONDO}$	1	0.850	0.782	0.700
ldup max (dev. relat.)	1	+ 1.3 %	+ 3.2 %	+ 5.5 %
ldup min. (dev. relat.)	1	+ 1.7 %	+ 4.4 %	+ 5.8 %

- The load may be increased as much as 50%!
- The production of GLY decreases!!

Conclusions for the Reactive Column

- The Process Simulator is able to reproduce the plant steady-state operating conditions with good accuracy
- A large extent of reaction occurs before entering the column
- The PO production is essentially not affected by operating conditions
- The GLY production heavily dpends on the energy input to the column
- The feed flow rate can be increased, with no change for the PO production; the GLY formation is reduced

Solvent Extraction of ε-Caprolactam

Conclusions for Caprolactam Extraction

- A thermodynamic model was developed, able to represent acceptably the phase behavior of a quaternary mixture containing electrolytes
- an effective simulation of the plant section considered was achieved, with satisfactory results
- the Process Simulator is now ready to simulate the behavior both of the existing plant when running at different operating conditions and of different plant configurations
- the subsitution of Benzene as the extracting solvent, which is under study, can be easily evaluated by using the Process Simulator

General Conclusions

The operation and optimization of industrial plants can be easily tackled by Process Simulators, BUT:

- the values of parameters required by the Process Simulator must be accurate, i.e. consistent with experimental data
- among other properties, it is of paramount importance to represent correctly both the equilibrium behavior and the reaction rates
- without a careful check of how these properties are evaluated, process simulation and optimization is a nonsense and a waste of time
- Process Simulators allow to perform *virtual* experiments on *real* production plants
- Process Simulators allow to perform feasibility analysis of newly proposed processes

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INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20 November 1998; Izmir-Turkey

The role of production process simulation to limit industrial pollution

Prof.Dr. Orhan USLU
Director, Dokuz Eylül University, Institute of Marine Sciences and Technology,
35340 Inciralti-Izmir, Turkey.
Tel.: +90-232-278 51 12; Fax: +90-232-278 50 82; E-mail: uslu@imst.deu.edu.tr

1. INTRODUCTION

As a mechanism of preventive care, the impacts of industrial processes should be assessed before the initiation of an activity in order to prevent any adverse effects before they actually take place and cause environmental damages. These assessments have to be made in a systematic, reproducible and interdisciplinary framework. Simulation provides a powerful tool for a wide-ranging, orderly and scientific appraisal of potential impacts on the abiotic and biotic components of the environment.

Today there are many well-developed, reliable and effective mathematical models that can be used for the impact simulation. Moreover the computer facilities have increased tremendously in the last years so that computational capacities pose no more a restriction to modeling efforts. The purpose of this presentation is to underline some principal aspects of simulation methodologies and to give some examples of simulations that have been used in various settings.

2. FRAMEWORKS OF SIMULATION

A tendency to use formal mathematical methods to understand complicated natural and man-made systems is characteristic for our time. In fact simulation is a more general mathematical tool that can be used to understand the behaviour of complex phenomena. It implies a step-by-step modeling of a phenomenon with the aid of a computer. The objective of simulation is to compute the states of the complex system on a model under variable initial and boundary conditions, and with different system settings or parameters in order to understand the performance of the real system. It allows testing a system under extreme conditions, the creation of which might be too difficult, time consuming, improbable, expensive and damaging on the prototype.

The areas and levels in which simulation can be used as a decision and planning tool are rather broad. Fig. 1 depicts frameworks of simulation that can be used in environmental studies. These frameworks are:

a) The process simulation proper

The aims of this simulation category are:

- to understand the inherent mechanisms in a production process,
- to assess the production technology,

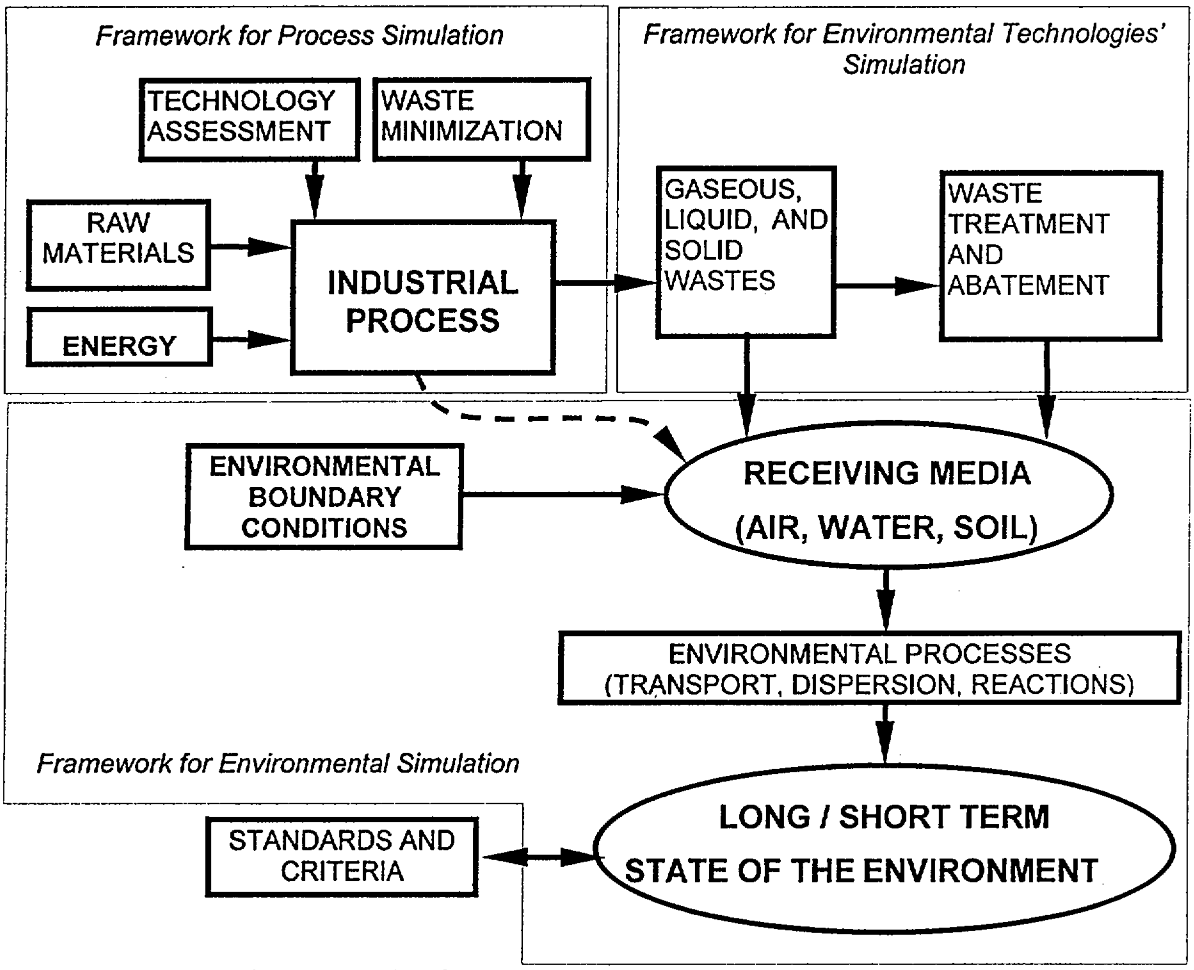

Figure 1: *Frameworks and levels of simulation in environmental impact assessment*

- to optimize the process with respect to raw materials, water, energy and labour consumption,
- to detect the process stages in which wastes are formed,
- to estimate the amount and composition of wastes and residuals,
- to minimize wastes and emissions of gaseous, liquid and solid substances which may impair the ambient environmental quality.

The process simulation can be used to plan a new process or to improve an existing one with respect to the above-mentioned objectives. Prof. Bertucco gives a very comprehensive treatment of simulation methods, as they are used in industrial process design and optimization, in this volume.

b) The simulation of environmental protection technologies

Once the behaviour of the industrial production process is understood and the amounts and compositions of wastes and residues are estimated, their conversion into ecologically less harmful and acceptable forms can be undertaken. Today, a broad spectrum of environmental protection and remediation technologies are available It is to be noted that these technologies consist of physical, chemical and biological processes that need again a proper design an optimization. Therefore the methods used for the simulation of the production process itself can also be used here. Hierarchization of the simulation frameworks can be introduced at this step for the simultaneous fine-tuning of the production process simulation proper and the processes that are used for the abatement of wastes.

c) Environmental simulation

Every human activity takes place in an ambience that is affected by its impacts. Whether the activity is optimized or not, and regardless the level of environmental protection technologies adopted, it is crucial for the protection of the surrounding ecological system to understand the material and energy fluxes in the environment that are caused by the activity. Natural processes such as transport and dispersion of material and energy as well as physical, chemical and biological reactions inherent to the environmental systems affect these fluxes. These natural processes are also controlled by boundary conditions driving the local or global environmental system.

The outcome of environmental simulation is the expected levels of contaminants and/or energy in the environmental matrices such as soil, water and air. These levels define the exposure of biotic elements of the ecological system to environmental stresses. These stresses are evaluated according to the duration of exposure. The environmental standards and criteria, as management tools, define the critical thresholds beyond which the ecological system elements may suffer some damage. The elements of the ecological system usually react to high level and short time exposure (acute effects) in a completely different way as to the low level and long time exposure (chronic effects).

3. LAWS OF CONSERVATION

In a *closed* system the amounts of mass, energy and momentum are conserved. Basic to the mathematical formulation of the dynamic phenomena in process simulation is the compliance with the laws of conservation of mass, energy and momentum. However the systems we consider are never closed. Therefore proper control sections have to be outlined that separate the process under consideration from the "rest of the world". At these control sections the balance equations for in- and outflowing mass, energy and momentum have to be defined. These balance equations have simply the following general form:

Storage = Inflow - Outflow

In processes with continuous variables, the equations are first written for an infinitesimally small element. These equations are then integrated together with the proper initial and boundary conditions to yield the solutions that define the overall systems performance. In cases where an analytical integration is not possible, this integration has to be performed numerically.

4. PHENOMENOLOGICAL LAWS

For some processes in which mass, energy or momentum is stored, the laws of conservation are not sufficient to describe the systems performance. Processes such as thermal transport, diffusion and chemical reactions develop in the direction of increasing entropy. These can not be brought back to their initial state without additional expenditure of energy and are called *irreversible* processes. For some irreversible processes the so-called "phenomenological laws" have been developed. Examples of these are:

Fourier's law: Heat is transported in the direction of temperature gradients, Fick's law: Material is transported by diffusion in the direction of concentration gradients,

Chemical reaction rates are proportional to a function of the temporal concentration gradients.

5. A CASE STUDY

A sizeable gold resource has been identified at Ovacik (Turkey), which is potentially of considerable importance to Turkey and the local and regional economy. It is a relatively high-grade deposit, with some intersects reporting gold grades of up to +30 g/ton. The deposit is amenable to processing technology widely used in the gold mining industry throughout the world (Fig. 2).

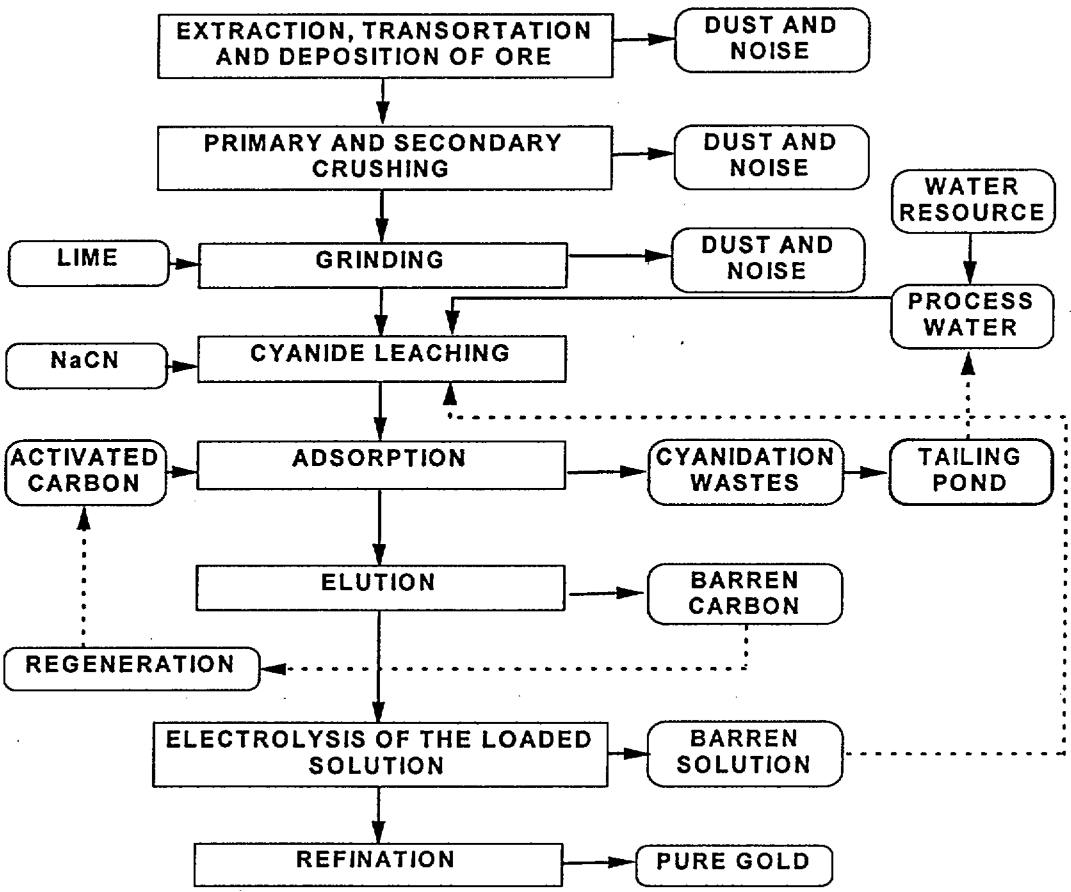

Figure 2: *Simplified flowsheet of the gold extraction process*

Emissions to the environment are shown in the flowsheet. The most significant effect has been figured out as the dumping of cyanide bearing slurry after the extraction process.

Theoretically, one of the most important impacts of mining activities can be the potential for release of cyanide and heavy metals. In the gold leaching process, the various metals contained in the ore form metal-cyanide complexes. These will report with the tailings from the process plant and be discharged as slurry to the tailings pond. Some of these metal cyanide complexes (copper for example) may disassociate quite readily, others such as iron, are relatively stable. The proportions of the various metal cyanide complexes and thereby the overall composition of the tailings will thus reflect the composition of the ore.

So far as cyanide is concerned, environmental mobility and toxicity depends to a large extent on its chemical form. The wide variety of cyanide compounds and their derivatives that may be present in tailings complicate predicting the environmental fate of cyanide. The compounds of cyanide can broadly be classified as free cyanides, simple cyanides and complex cyanides.

Free cyanide, as hydrogen cyanide, is generally regarded as the environmentally hazardous form of cyanide. Unfortunately, although cyanide readily forms complexes with a variety of metals, most of the complexes readily dissociate to free cyanide.

There are various factors which will control cyanide degradation and hence determine any possible effect on groundwater in the event of seepage migrating from the tailings pond. These are: (a) Volatilization; (b) Retention on solids; (c) Leaching; (d) Retention of cyanide on geological material; (e) Retardation; (f) Attenuation; (g) Degradation

In support of this, it can be confirmed that there is considerable information from operations around the world that retardation and degradation may significantly reduce the potential environmental impact of cyanide. The tailings also have a very high capacity to adsorb metals from solution and this will mean that there will be sufficient time for any dissolved metals in any seepage water to contact the adsorbing surfaces or precipitate out.

Simulation of the Tailings Pond Performance

The tailings reservoir in Ovacik gold mine has been designed as a continuous-fill system. It retains all influent until the reservoir is full. To estimate the rate of change of stored water, volumetric inputs of precipitation and slurry and outputs of recycle water, water retained in the sediments and evaporation have to be taken into consideration (Fig. 3).

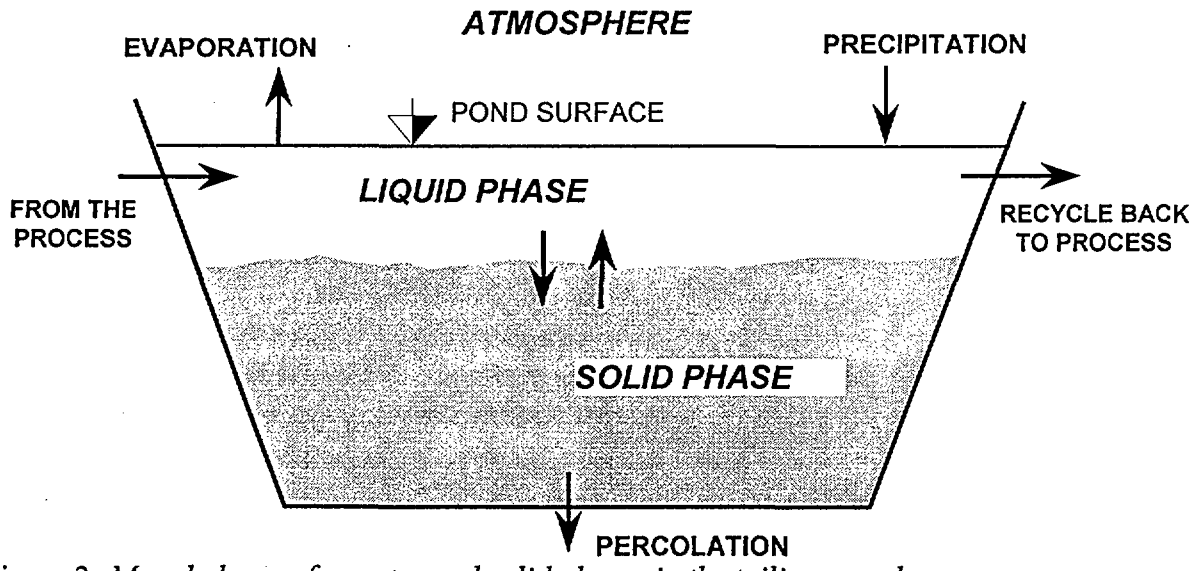

Figure 3: *Mass balances for water and solid phases in the tailings pond*

From the point of view of water utilization and reuse of chemicals discharged into the tailings reservoir a high recycle rate is recommended. The upper limit of the recycle rate will be determined by the drainage system and the portion of water, which is confined as pore water in the deposits.

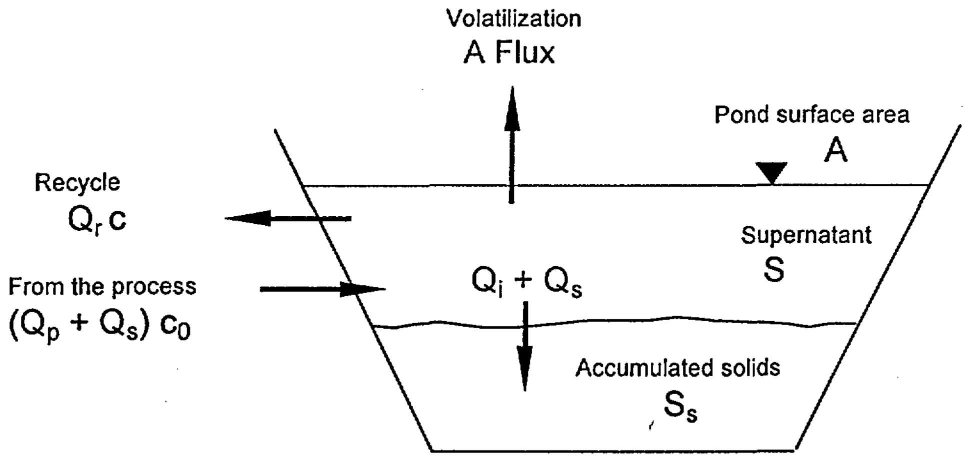

Figure 4: *Cyanide balances in the tailings pond*

Notwithstanding these considerations, a hypothetical mode of operation which allows for a ponding of water on the surface of the tailings reservoir has been investigated for the sake of understanding the magnitude and effects of potential cyanide emissions to the atmosphere. This approach has been used for the sake of theoretical integrity of this investigation and complies with the "worst-case approach".

A recycle rate of 55% is chosen to represent the hydraulic behaviour of the tailings reservoir for this mode. In this case a supernatant of 0.1-3 m will be present on the top of the accumulated sediments and the average water level will be the smallest during the whole period of operation, a condition that maximizes the volatilization and atmospheric emissions of cyanide.

In the computer simulation studies with various degradation rate parameter choices the free cyanide concentration in the pond supernatant has been found to vary between 25 and 100 gHCH/m^3. The range of variation of concentrations of metal-cyanide complexes has been found to vary between 5 and 70 g/m^3 expressed as HCN. The emissions exhibit a seasonal variation depending on the temperature of water in the pond. The emissions from the water surface vary between 2-22 kgHCN/h. The typical average value was 8 kgHCH/h.

The values found in the simulation experiments for both free cyanide and metal-cyanide complexes show that considerable reductions in concentration of cyanide species are achievable in the tailings pond with a large exposed surface to the atmosphere. Note that the input concentration of free cyanide was 350 gNaCN/m^3 (193 gHCN/m^3) and that of the metal-cyanide complexes was 1150 gNaCN/m^3 (634 gHCN/m^3).

Simulation of the Atmospheric Dispersion of Cyanide

Atmospheric cyanide (HCH) concentrations in the tailings pond area result from the emissions from the pond surface. These concentrations depend upon the dispersion potential of the air masses above the tailings pond which is a function of wind speed and the atmospheric stability. These parameters obviously have a great variability.

Atmospheric cyanide concentrations in the immediate vicinity of the tailings reservoir have been simulated with a simple computer routine according to the Turkish Regulations for Air Pollution Control. The tailings pond has been idealized as an aggregation of 10x10 point sources located on a mesh of 40x40 m at the ground level. Each point source has been assumed to have equal intensity, i.e. emitting at a rate of 1/100 of the total.

Dispersion Experiment I

To be on the safe side from the environmental point of view, a worst case analysis has been considered. The analysis is based upon the maximum rate of emission found in the preceding simulations (22 kgHCN/h) and an atmospheric stability class of "extremely stable" together with a wind speed of 1.0 m/sec which characterize conditions of minimum dispersion potential according to Turkish Regulations for Air Pollution Control.

The results of this simulation are given in Table 1. The maximum predicted ground level cyanide concentration occurs in the middle of the pond (478 μgHCN/m^3 as highlighted in the table). At the boundary of the mining area the maximum predicted concentration is 209 μgHCN/m^3. The concentrations further die off rapidly within a short distance from the boundary of the mine. These calculations show that even in the "worst-case" the concentrations in the mine area will remain far below the ILO limit of 10 mgHCH/m^3 (10000 μgHCH/m^3) given for allowable long term (8 hours) human exposure under working conditions.

Table 1: *Ambient HCN concentrations (μg/m3) for an ENE wind with a velocity of U_h=1.0 m/sec and atmospheric stability class E resulting from an emission of 22 kgHCH/h*

	2000	1500	1000	500	0	500	1000	1500	2000
2000	0	0	0	0	0	0	0	0	0
1500	0	0	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0	0	0
500	0	0	0	0	0	0	0	0	0
0	5	12	41	209	478	0	0	0	0
500	45	86	136	96	1	0	0	0	0
1000	55	43	14	0	0	0	0	0	0
1500	14	4	0	0	0	0	0	0	0
2000	1	0	0	0	0	0	0	0	0

Note: The origin of the coordinate system is located at the centroid of the area source; the positive x- and y-axes are directed towards E and N respectively

Dispersion Experiment II

The probability of occurrence of the initial and boundary conditions as defined in Dispersion Experiment I is quite unlikely. In a second simulation, average conditions have been taken as a basis. The emission rates will normally not exceed 7-8 kgHCN/h as has been found out in the pond performance simulations. As a typical atmospheric stability condition class C/1 and wind velocity 3.0 m/sec have been chosen.

The results of this simulation are given in Table 2. As can be seen from these, the maximum predicted ground level cyanide concentration occurs in the middle of the pond (54 μgHCN/m^3 as highlighted in the table). At the boundaries of the mine site the maximum predicted concentration is 14 μgHCN/m^3. These levels of concentrations have no environmental significance. Probably they are not even detectable by analytical procedures.

Table 2:*Ambient HCN concentrations (μg/m3) for an ENE wind with a velocity of U_h=3.0 m/sec and atmospheric stability class C/1 resulting from an emission of 8 kg/h*

	2000	1500	1000	500	0	500	1000	1500	2000
2000	0	0	0	0	0	0	0	0	0
1500	0	0	0	0	0	0	0	0	0
1000	0	0	0	0	0	0	0	0	0
500	0	0	0	0	0	0	0	0	0
0	0	0	2	14	54	0	0	0	0
500	2	4	7	5	0	0	0	0	0
1000	2	2	1	0	0	0	0	0	0
1500	1	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0

Note: The origin of the coordinate system is located at the centroid of the area source; the positive x- and y-axes are directed towards E and N respectively

Still a very important difference between the given ILO standard and the allowable ambient concentrations of air pollutants, which are valid outside the boundaries of the plant site, must be mentioned here. For HCN there is no ambient threshold value in Turkish Regulations for Air Pollution Control. Neither it was possible to find a relevant ambient standard in regulations of foreign countries. For this reason, a comparison has been made between the ILO standards and short-term average values for various other air pollutants as given in the Turkish regulations. The results of this comparison are summarized in Table 3.

As can be seen from the table the ratio of ILO standards and STA values for various pollutants varies between 10-150. The predicted value of 209 μgHCN/m^3 at the boundary of the mine site yield a ratio of 47.8, which can be esteemed to secure adequate guarantee for human exposure.

Table 3: *Comparison of ILO standards and short term average values for various air pollutants*

Gaseous Pollutant	Short Term Average STA ($\mu g/m^3$)	ILO Standard (8 h) ($\mu g/m^3$)	Ratio ILO/STA
HCN	-	10000	-
H_2S	100	15000	150
HF	30	2000	67
SO_2	900	13000	14.4
HCl	300	7000	23.3
NO_2	300	9000	30
NO	600	30000	50
Cl_2	300	3000	10

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INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

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Data acquisition, processing and the use of Geographic Information Systems for integrating information

A. Hüsnü Eronat & Erol Saner

Institute of Marine Sciences and Technology

1. Introduction

The Institute of Marine Sciences and Technology became involved in remote sensing and Geographical Information Systems in early 1990s. The Institute established its Automatic Picture Transmission (APT) and Meteosat ground receiving station in early 1991. Later this receiving station was moved to the Institute's research vessel R/V Piri Reis. In the same year, the Institute began to give courses on Remote Sensing Applications in Marine Science. In 1994, a High-Resolution Picture Transmission (HRPT) earth station, SMART Station was established at the Institute's Inciralti facilities. In 1995, the Institute was accepted as a official site to receive SeaWIFS data. And also the Institute receives TOPEX/POSEIDON Products. The Institute has an archive of Landsat/TM and Landsat/MSS images of the entire Turkish coastal zones. In 1997, Institute was able to conduct Digital Air Video survey with its own equipment.

Today the Institute has the ability to carry out any type of remote sensing and/or GIS project from beginning to end.

In 1994, the Institute gave a training course on Remote Sensing and GIS in Coastal and Estuarine Management where Greek and Dutch experts came to the Institute and gave courses. In 1995, the Institute began a European Community project, the AVICENNE Programme AVI*-CT93-0006, "Mediterranean Non-point Sources of Pollution MED-NPS" together with Italian, Greek and Egyptian partners and successfully finished. The Institute also gives Master and Ph.D. Theses on remote sensing and GIS within the context of its Coastal Zone Management and Marine Sciences programmes.

1. SMART Station

The SMART Station is the main data source for the Institute. The SMART Station has the ability to capture images from east of the Caspian Sea to east of the Atlantic Ocean and from the North Sea to south of the Red Sea. For practical reasons the Institute only stores images from the Institutes main interest areas which are the Black Sea, Aegean Sea and Eastern Mediterranean Sea.

The SMART Station has ability to acquire and process real time HRPT data and SeaWIFS data from the NOAA series of polar-orbiting environmental satellites (currently NOAA 10, NOAA 12, NOAA 14 and NOAA 15).

Today, the Institute's earth station receives two images, one day-time and one night-time, per day.

The day images are used for determining Suspended Sediments, Pollution, Plankton Distribution, Currents and Gyres, which effect reflectance. The day images also may be used for Normalized Difference Vegetation Index (NDVI).

The night images are used for determining the Sea Surface Temperature (SST).

SMARTrack performs all necessary functions, including:

- Configuration and control of the SMART Antenna;
- Control of the HRPT radio electronics;
- Orbital modeling for on-screen satellite tracking and scheduling data acquisition;
- Maintains accurate time using a GPS antenna;
- Captures HRPT and SeaWIFS data from the NOAA series of environmental satellites;
- Acquires orbital elements by connecting with SMARTech using SMART Link;
- Calibrates AVHRR and SeaWIFS data;
- Calculates earth location points for AVHRR and SeaWIFS data;
- Determines sun and satellite zenith angles for AVHRR and SeaWIFS data;
- Exports AVHRR and SeaWIFS data to ERDAS or NOAA Level 1B for processing.

3. Digital Air Photography and Videography

The Municipality of Izmir needed an aerial survey to monitor the situation and local changes in their area of responsibility on a 1/25.000 scale. Even though the need for the multispectral information was initially for qualitative visual analysis, a quantitative analysis using automated computer based-techniques was also constructed at the end of this study.

While the budget for the study was limited, a simple and an economical air videography system was used to carry out the study. This approach was motivated by the need to create a new low-budget system.

The objective of this paper is to introduce the system and the applications completed for this area in the Aegean Region of Turkey.

3.1. AIR VIDEOGRAPHY SYSTEM

The study was planned to construct an economical way for air surveys. For this purpose, first the digital video camera market was researched to find an appropriate product. The result was the selection of a Panasonic EZ1 video camera that has a good performance and price balance compared to others in the market at 1997. It was selected by using criteria necessary to achieve sufficient results in the computer work. Being specific, these criteria are:

Digital image transfer capability of the camera

The selected one has only an analog output but while Panasonic was preparing a DV cassette driver for personal computers, it was found acceptable for use in the near future.

CCD structure of the camera

It has 3-CCD, which provides the ability to handle RGB channels independently.

Pixel capacity of the CCD

The CCDs used in the camera have 380.000 pixels, which was sufficient enough for this technology at this time.

Suitability to mount to an airplane

The video camera was suitable for this purpose due to its size and shape.

Wide angle lens usage possibility without distortion

The 30-70-mm lens and an undistorted 0.5X converter, provide images to eliminate distortion.

After the selection of the camera, it was necessary to construct the whole system for the envisaged air videography study and this step was the application of the GPS to the system. While the aim of the study was mainly qualitative, a small hand GPS (Garmin-90) was found suitable for the study. It was decided to use the GPS connected to a notebook computer running a navigation program.

HYDRONAV is a program used in the marine researches of the Institute of Marine Sciences and Technology (IMST) and it was decided to use it also for the airplane survey. The program served two different purposes. The first was a graphical guidance for the pilot in different zoom levels through the help of preprocessed routes before the flight and current position data during the flight. This was indeed a chance of using small and older airplanes even without an autopilot and a GPS system. The second service of the HYDRONAV was the recording of the routes along the time in the needed pre-defined frequency.

The GPS information and the images were connected via the time recordings of the video camera and the coordinate - time pair recordings of HYDRONAV.

The only detail that must be considered was the image capturing system while the DV drivers were not on the market yet. A TV card (Pixelview) that can give up to 1024 x 768 pixel resolution was selected for image capturing and transferring the images to the computer environment. This was the finalization of the system (Fig.1).

3.2. SOFTWARE

One of the important steps of the project was the image patching. A practical and a fast patching algorithm was necessary to patch 1600 images. A new software has been developed in the IMST for this purpose consisting of two different components called IMST Mosaic and IMST MapView. The brief details of these computer programs are given below.

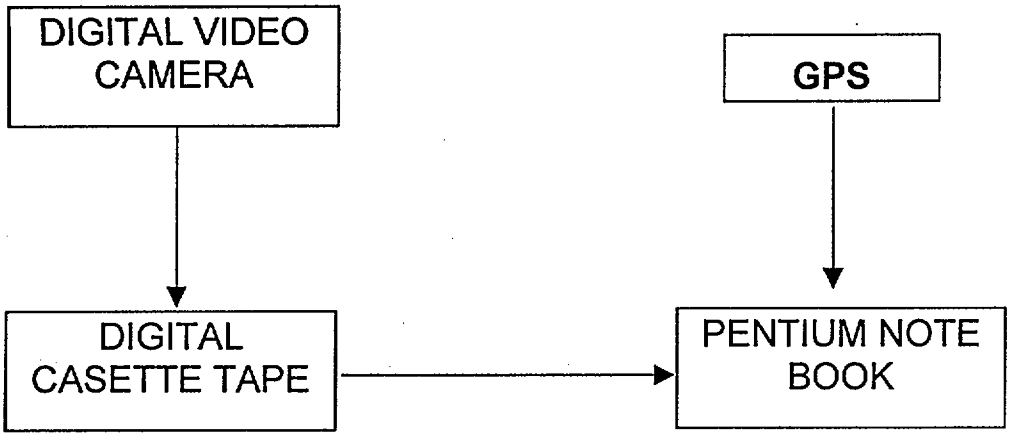


Figure.1: Air videography system used in the study.

Three people with the help of the constructed software have completed the mosaicing part of the project for 1600 images in a week. The aim of the creation of those programs was to show the user a general map composed of the mosaiced images and then help him to reach the individual image of the area he needs by only using a mouse. This means that those programs serve to construct a visual database giving the user a simple visual catalog system to acquire the needed image.

a) IMST Mosaic

This program is a tool for patching the unprocessed images. It uses the low-resolution counterpart of the images for this purpose. The main idea in the creation of the program was to get access to the images for qualitative studies. This was the motivation and while the coordinate details and mapping type of accuracy were not needed, the visual aspects became the focus.

The program is prepared for Windows 95 environment and was capable of using a common database and data from the network. It basically has three different functions that can be applied to every individual image as well as to a selected group of images easily and quickly by the help of the mouse. These are:

Sizing

Rotating

Moving

The program is basically controlled by a database system (Microsoft Visual FoxPro) handling the relative coordinates of the images mosaiced. The main idea was to use the program in unlimited different levels of hierarchies, which is constructed by the help of database system and the algorithm generated during the study. This structure leaded to mosaic the images as small groups first, then mosaic those groups to each other again to form larger groups and continue the procedure until reaching the one largest image of the study area.

b) IMST MapView

This program is prepared only to view the images mosaiced by IMST Mosaic software. It uses the same patching levels from the database system created during the mosaic studies to reach an individual image. First the groups constituting the image can be selected and brought to the screen, then the smaller groups constituting this group is selected and brought to the screen and this system continues until reaching the individual image. The program has the capability to use the data from a hard disk drive or from a CD drive.

3. STUDY AREA

The study area is located in the Aegean Region at the western coast of Turkey. The extent of the study area is approximately within the borders of the Province of Izmir and size of the area is ca. 11.000. While the coastal parts are flat in the region, the inner parts have huge mountains rising up to 1500-m height, which is an important aspect that must be taken into account during the air videography studies. Another difficulty was caused by the international Adnan Menderes Airport of Izmir having heavy air traffic load.

4. METHODOLOGY

4.1. Field Work

In the beginning of the study it was necessary to test the system for detecting the problems that would occur during the application phase. A small subregion of the actual study area was chosen for this purpose and the trial cruise was planned in the same way as the real study. During this cruise all the aspects of the system were under control and many pre-planned experiments have been done. In the appraisal of those experiments it was seen that there was no problem in the use of the system on the airplane and in the acquisition of images. It was observed that the most important details affecting the results were the camera controls. The optimum configuration was obtained by these experiments and the system became ready for the real application.

The study was carried out using a small Cessna airplane and the air videography system given in Fig.1. The study area was divided into North-South trending flight lines, which allowed a 30% sidelap to the adjacent lines. Nearly 45 flight lines were covered within 35 hours of flight including the first trial flights and repetition flights for data correction. Every cruise was arranged approximately as a 4 hours fight and the total area is covered in 25 days according to the schedule of the project.

The flight height during the study was 3000 m and the area covered by each individual the image was 3.2 km X 4.8 km.

4.2. Laboratory Work

After the completion of the fieldwork the video images were taken in to the laboratory for processing. The steps in the laboratory work can be summarized as follows:

The images along a route were captured with 60% overlap via Pixelview TV card in 800x532 pixel format via K6-200 processor computer having 64Mb RAM and this gave a resolution of 5.5 m/pixel. The images are handled as 24-bit color TIF format.

The TIFF images were converted to low resolution BMP format for fast processing with IMST Mosaic software in visual cataloging procedure.

Using the BMP images and IMST Mosaic the patching was completed and transferred to compact disks as a set of data and programs.

5. CASE STUDY: TAHTALI DAM AND RESERVOIR

5.1. The purpose of the study

Izmir Municipality, Water and Sewer Administration Management (IZSU), Water Purification Permit Inspection Branch had to expropriate 2,352 hectares of mostly cultivated area for the building of the Tahtali Dam. This authority needed to know the exact value of the properties; therefore, they gave a project to the Agricultural Engineering Department of the Aegean University to determine the economical value of these properties through the use of a questionnaire. However, because of the inadequacy of the land register data the outcome of the project was a failure. Therefore, the Water Purification Permit Inspection Branch gave another project to the Institute of Marine Science and Technology (IMST) to determine the land use and crop type by using digital images, which were acquired for the Izmir Municipality.

5.2. Study Area

Tahtali Dam is located at the south of the city of the Izmir and to the northeast of the Gumuldur province. It will provide 128x106 m3/year potable water, which will be collected in a 546-km2 drainage area for the city of Izmir. After the completion of the project an area of 2,352 ha will be flooded upstream of the 54.5-m height dam.

5.3. Image Processing

In this investigation flights at two different altitudes were realized. In the first flight, the plane flew over the dam area at approximately 1000 feet because of the Adnan Menderes Airport restrictions and the height of the mountains surrounding the area. These images were used for the differentiation of the land and crop type. The second flight was conducted at the altitude of 3000 feet and 5.5-m resolution digital images were collected, which were used for the base map for this project.

In the first stage of the project, digital images (in TIF format) were manually registered in PhotoShop Image Processing Software to determine the general location of the dam area. The resulting images were used for differentiation of land and crop types and for planning the location of the Ground Control Points (GCP) for the detailed rectification by using DGPS.

In the second stage of the project, field studies were conducted. A Training Sample Location for each crop was determined and also DGPS measurements were compiled for accurate ground coordinates.

In the third stage of the project, each digital image was transferred to IDRISI format (.IMG) and rectified to Universal Transverse Mercator by using the already obtained GCP coordinates. Then, all the georeferenced images were registered to each other to create a mosaic for the study area. By using Training Sample Location information and visual information, which was obtained from the low altitude flight and site visits, crop types of the mosaic image were vectorized, with interactive screen digitizing, into 14 areas. Then these vector files were converted into signature files by using MAKESIGN Module. These signature files were used as input to the MAXLIKE Module, which undertakes a maximum likelihood classification of the mosaiced image based on information contained in previously obtained 14 signature files. As a result of this procedure a classified image, which consists of 14 classes was created. These classes are; road/bare land, swamp, wood, olive grove, settlements, tobacco, grain, scrub/meadow, vineyard, greenhouse, water, vegetable, fruit trees and cotton. AREA Module was used on these classified images to measure the areas associated with each of the classes.

The map of IZSU Tahtali Dam Protection Zones was digitized and used to determine future borders of the Tahtali Dam reservoir after the water rise to its maximum level. At the same time this digitized map was used to mask, measure and determine the land and crop types of the absolute protection zone, close protection zone and medium protection zone.

5.4. Results

This study proved that digital air video images, together with the use of image processing and GIS techniques is an excellent way to create detailed land use and crop type maps for many purposes.

GUIDELINES, METHODOLOGY AND CONTENT OF A PRE-INVESTMENT STUDY IN A "HOT SPOT" AREA

Dimitrios Tsotsos, Athens

OUTPUTS

Decision makers have to be provided with:

- A list of classified pollution sources within a hot spot area
- ranking of pollution sources for setting priorities for investment
- description of alternatives-options of amelioration activities
- environmental, technical, organizational and financial specifications of projects to be formulated and financed

Ranking of pollution sources

Specific Criteria

Environmental criteria

- preservation of existing biotopes
- specific conditions of water recipients

Socioeconomic criteria

- limited resources of enterprises to finance environmental investments
- inadequate administrative/organizational framework for the enforcement of standards
- pressure of local population for immediate actions
- on-going planned environmental investments in the area
- preparation of regional development plans, master plans etc.

Environmental Impacts

Impacts caused by effluent discharge on:

- the sea
- nearby surface waters
- groundwater
- soil

- plantation

Impacts caused by sludge treatment/disposal on:

- soil
- groundwater
- air

Other impacts caused by plant's operation :

- odours
- mosquito breeding
- noise
- traffic
- impacts on landscape

Impacts caused by solid waste disposal / treatment on :

- the sea
- nearby surface waters
- groundwater
- soil
- air

Other impacts caused by sites'/plants' operation :

- mosquito breeding
- noise
- traffic
- impacts on landscape

Public Health Risks

Public health risks are related to :

- water quality deterioration
- impacts on crops

Socio-economic Impacts

The following factors reflect some of the major social and economical conditions to be considered during the decision making process :

- role of environmental protection for local economy
- land use planning
- reforestation requirements
- existing infrastructure
- administrative requirements

- manpower requirements for plant's operation - management
- acceptance of alternatives by local population

Definition of Criteria

CATEGORY	RANKING VALUE
a) environmental criteria	
1.impacts on : sea water	8
2................. : groundwater	7
3................. : surface water	5
4................. : soil	4
5................. : air	3
6................. : landscape	3
7.conservation of resources	5
Total	35
b) hygienic criteria	
8.injection risks for population	20
9.impacts on sea uses (bathing, fishing etc.)	15
10.groundwater contamination	10
Total	45
c) technical / economical criteria	
11.construction costs	4
12.operation / maintenance costs	6
13.land occupation	5
Total	15
d) specific criteria	
14.requirements for additional infrastructure, manpower, administration	3
15.acceptance of projects by the public	2
Total	5

Waste Collection-Treatment

Municipal liquid wastes

The following parameters should be considered for collection systems :

- Design period
- wastewater characteristics
- design flow

- type of sewer system
- topography - morphology of the area

Industrial liquid wastes

The following aspects for <u>*end-of-pipe*</u> *systems have to be considered:*

- Collection system per industry
- combined collection system for more than one industries
- wastewater characteristics
- design flows
- treatment efficiency requirements

For the application of <u>*clean/recycling technologies*</u> *the following factors must be assessed:*

- Mass/energy balance of industrial process
- operational parameters of industrial process
- waste characteristics of industrial process
- requirements for removal of pollutants according to set effluent standards
- characteristics of clean technologies to be applied

Disposal of Effluents

- Discharge into the sea
- Discharge into freshwaters
- Discharge into estuaries
- Reuse of effluents

Treatment - Disposal of sludge

Design, Construction and Operation of plants

The design deals with the technical aspects of the decided project containing all necessary data for its evaluation, such as :

- Flow diagrams
- process design
- operational characteristics
- construction - operation aspects

Process Analysis

- Process flow sheets
- definition of design criteria
- mass balance
- hydraulic profile
- selection - design of reactors

For the plant layout the following aspects have to be considered:

- Geometry of site
- topography
- soil-foundation conditions
- location of influent sewers
- location of discharge point
- transportation access
- additional area for future plant expansion

Equipment

- Durability - resistance to chemicals
- safe and simple operation
- environmental suitability
- costing

Institutions

- operating unit of facilities
- coastal water control authority for the hot spot area
- regional / national authority responsible for policy formulation - implementation

Capital - O/M Costs

Capital costs	O/M costs
construction engineering land occupation legal, fiscal, administrative interest rate during construction phase	personnel energy chemicals water miscellaneous utilities miscellaneous supplies-materials

Cost-benefit Analysis

a) Assessment of the project area

- coastal line and hinterland
- natural environment
- demographic-development trends

b) Environmental quality

- pollution sources/loads
- environmental-health impacts

- existing-planned pollution control facilities and measures

c) Cost analysis

- loss-depreciation of natural resources
- negative impacts on health
- investments for pollution control with associated O/M costs
- monitoring of pollution

d) Identification-quantification of benefits

- improvement of agricultural production, touristic and recreational activities
- positive impacts on health and on the environment
- increase of land values

Pollution hot spots ranking system

Extreme effects (6)

severe effects (5)

major effects (4)

moderate effects (3)

slight effects (2)

no effects (1)

Extreme effects (6)

severe effects (5)

major effects (4)

moderate effects (3)

slight effects (2)

no effects (1)

For:

- Public health
- Drinking water quality
- Recreation
- Other beneficial uses
- Aquatic life
- Economy and welfare

INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20 November 1998; Izmir-Turkey

MEDITERRANEAN SEA FISHERIES-EGYPT

Abd El Rahman abd El Razek Salama, Egypt.

The Egyptian Mediterranean Sea coast is about 1100 km in length, extending from Sallum in the west to Rafaa in the east. The continental shelf to 200 m in depth along the coast is composed largely of silty mud and muddy sands. It widens up to maximum of 70 km in the front of the delta. The fishing grounds along this coast can be divided into three distinct zones:

i) Western zone, extending from Sallum to Alexandria, a length of about 600 km;

ii) Central zone, from Alexandria to Port Said, about 300 km

iii) Eastern zone, from Port Said to El Arish, about 200 km.

Most of the fishing operations are concentrated in the central zone, in the area between Alexandria and Port Said, and mostly using trawlers at a depth of 10-100 meters. Besides demersal species, pelagic fish, such as sardines were, up to 1965, one of the major components of the catch during the flood Season (from August to October).

The catch from the Mediterranean Sea exhibited a substantial increase in the 1950's up to the beginning of the 1960's due to the growth of the fishing fleet and its mechanization. The number of motorized boats increased rapidly from 428 in 1958 to 662 in 1962. This growth resulted in an increase in the catch to about 37.800 tons in that year, the highest catch figure ever reached from the Egyptian waters of the Mediterranean Sea. Sardine and Shrimp constituted more than 60 percent of the catch.

This situation was altered drastically by the construction of the Aswan High Dam, which stopped, or largely reduce the flow of nutrients carried by the Nile to the Sea. Production of demersal fish, sardine, and shrimp has declined considerably over the last 20 years. Pelagic fisheries, largely sardine, dropped from an annual production of about 18.000 before the construction of the High Dam to not more than 500 tons in 1966, in spite of increased efforts. The sardine fishery has never revived and nowadays the catch does not exceed 2000 tons up to 1985. Likewise, shrimp catches, which averaged around 10,000 tones for years have also decreased sharply to about 3800 tones apparently also in relation to the new flow regime of the Nile. However, one can not ignore the intensive fishing of immature shrimp and fry of mullet species in the North Delta lakes, which are connected with the Mediterranean Sea (Lakes Manzalah, Borollos and Edku).

The zoea larvae and young of some shrimp species as well as fry of mullet species enter these lakes for shelter and feeding, and then migrate back to the Sea to mature and spawn. During this lake phase of the life history, young immature shrimp are usually subjected to intensive fishing. In some years the catch of young shrimp has reached 1000 tons from Lake Manzalah alone. This adversely affects the stock of shrimp in the Sea, also the fry of mullet species suffer from over fishing because of aquaculture activities which are increasing in the recent time. Measures taken to prevent fishing of young shrimp and fry of mullet in the lakes or shallow waters might be tried to restore the fishery.

As regard demersal fishes, their catches also decreased from 31.000 tons in 1964 to a minimum of 7140 tons in 1970, but rose again to 10.500 tons in 1974, to 13.000 tons in 1975 to 19.900 tons in 1980 and then dropped again to 11.200 tons in 1982. The substantial increase in the catch of demersal fishes after 1970 was moinly due to the increased number of motorized boats in the Mediterranean Sea to 1260 boats in 1970 and further to 2166 boats from 1980 till 1982 and increased again to 2807 in 1996 till the present (Table

It is apparent, that the initial increase in the total catch from the Mediterranean Sea in the years from 1966 onward was due to the increase of fishing effort. However, as this effort reduce the stocks of demersal species to the extent that the catch per boat (if taken as catch per unit of effort) dropped from 57.1 tons/boat in 1962 to 5.7 tons in 1970. Then it rose a little to 9.2 tons per boat per year in 1980. The stocks could not sustain the effort of the number of motorized boats, which had doubled between 1970 and 1980. The further effect of this elevated fishing intensity was felt in 1982 when the catch per boat dropped again to 5.2 tons per year but the catch per boat rosed again and reached 18.79 tons per boat in 1997 was due to that many fishing boats are operating in the neighboring countries water and their landed included in the national landings of the Mediterranean, further more the increasing of horse power of many vessels permit to operate in new fishing grounds. The situation of the Egyptian Mediterranean Sea fisheries can be further demonstrated by the contribution they make to the total fish production of the country from 1958 to 1997 as shown in the table.

Changes in the area of Mariut from 1950-1994

Year	Area (per fed.)
1950	32600
1955	31370
1973	16280
1981	16240
1994	15000

Fish production of Mariut Lake, 1962-1990(in thousand tons)

Year	Production	Year	Production	Year	Production
1962	7.8	1981	11.4	1986	5.6
1965	6.8	1982	10.0	1987	4.4
1970	2.1	1983	7.2	1988	3.0
1975	17.1	1984	8.4	1989	2.1
1980	14.1	1985	5.5	1990	1.7

Water pollution identification:

'Pollution means quantitative or qualitative changes in the living and nonliving components of the water environment which negatively affect the natural resources available for human uses.'

- The total value of fish production represent 4.4% from the total Agricultural income
- Main fish species are: Tilapia (35%), carp (8.5%), mullet (7.14), catfish (5%) and sardine (3.56%).
- Per capita consumption 10.4 kg/year (1997).
- Total fish export in tons 2233 (total value L.E. 45.0 million).
- Total fish import in tons 207000 (total value L.E. 415 million

Egyptian Fish Production from different Resources 1985-1997 (in 1000 tons)

Resource	1985 Production	%	1997 Production	%
Marine resources				
Mediterranean Sea	33.000	13.4	52.748	11.5
Red Sea	22.000	8.9	57.4176	12.6
Brackish water				
Manzallah Lake	66.000	26.8	63.o98	13.8
Burollos Lake	127.000	6.9	58.746	12.8
Edku Lake	6.600	2.7	10.784	2.36
Quarun Lake	1.500	0.6	0.906	0.20
Rayan	0.900	0.36	0.876	0.19
Mariout Lake	7.700	3.1	4.489	0.98
Bardaweel Lake	2.7000	12.1	2.230	0.49
Port Fouad Lake	0.600	0.2	0.154	0.03
Bitter Lakes			1.722	0.38
Inland Freshwaters				
Nile and canals	22.000	8.9	65.535	14.3
High Dam Lake	28.000	11.4	52.627	11.5
Grass carp	-		12.250	2.68
Culture Fisheries	38.000	15.4	73.454	16.1
Total	**246.000**	**100**	**457.036**	**100**

Proportion of Egyptian Fish Production in Mediterranean Waters (in thousand tons)

Year	Total Catch	Mediterranean Catch	% of Mediterranean Catch
1958	80.400	35.147	43.7
1962	124.159	37.832	30.5
1966	88.000	15.048	17.1
1973	93.500	9.600	10.2
1975	106.574	5.384	5.1
1977	104.541	6.683	6.4
1980	140.397	17.466	12.4
1982	137.208	11.708	8.2
1985	246.000	33.000	13.4
1997	457.036	52.748	11.5

Effort and Catch in Egyptian Mediterranean Fisheries (1962-1997)

	1962	1966	1970	1980	1982	1997
No. of boats	662	662	1260	2166	2166	2807
No. of fishermen	-	18329	25916	25916	-	27704
Catch in tons	37832	15048	7142	199930	11208	52748
Catch/boat/year (tons)	57.1	22.7	5.7	9.2	5.2	18.79

Main species in Mediterranean are: Sardine, Shrimp, Cuttle fish, Crabs, Bogue, Brushtooth lizard fish, Barracuda, Seabream, Seabass.

Industrial Water Pollution by Areas

Region	No. of units	Drainage in mill m3/year	Drainage sites				Drainage type		
			Nile and branches	Drainage canal	Sewage	Underground and lakes	Indust.	Sanit.	Cool.
Greater Cairo	126	127.5	80	21	20	6.5	63	6.5	58
Alexandria	85	88	13	7	33.3	34.7	56.4	4.6	27
Northern Egypt	60	125	27	84.5	12.5	1.0	55.2	10.6	59.2
Upper Egypt	25	204	192	5.0	2.0	5.0	87.6	8.3	108
Suez Canal and Remote Governorates	24	4.5	-	0.2	3.3	1.0	2.8	0.42	1.28
Total	330	549	312	117.7	71.1	48.2	265	30.42	253.5
%		100	56.8	21.4	13.1	8.7	48.1	5.5	46.4

Agriculture Intensification Rate in A.R.E. through the Period 1985-1990 (in 1000 fed.)

Year	Cropping area	Cultivated area	Agr. Int. rate
1985	11220	5495	2.042
1986	11226	5537	2.027
1987	11419	5714	1.998
1988	11497	5696	2.018
1989	11773	5925	1.987
1990	12094	6248	1.936

Chemical Fertilizer Used in Egypt from 1985-1991 (in 1000 tons)

Year	N-fertilizers	P-fertilizers	K-fertilizer	Total
1985/86	5060	1223	51	6334
1986/87	5079	1236	60	6375
1987/88	5104	1272	61	6437
1988/89	4983	1208	56	6547
1989/90	5007	1099	44	6150
1990/91	4678	1230	58	5966

Pesticide Consumption in the Period of 1985-1990 (in tons)

Year	Insecticide	Fungicide	Herbicide	Total
1985	9162	4891	2362	16379
1986	13574	7552	2335	23461
1987	12184	6871	1663	20718
1988	9727	5132	1738	16597
1989	-	-	-	-
1990	8825	4983	1517	15325

INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20 November 1998; Izmir-Turkey

PLANNING MONITORING SYSTEMS INCLUDING THE ASSESSMENT OF INDUSTRIAL LANDSCAPE PATTERNS

Esin Ucuncuoglu, Hüsnü Eronat; IMST

1 Introduction

An important management aspect of coastal areas is to satisfy the coastal water quality needs. Direct discharge of domestic and industrial wastes in the coastal waters is an important concern. Many industries are attracted to the coastal zones where they (Clark, 1996)

1. Benefit from access to low cost marine and inland transportation systems
2. Availability of sea water for process or cooling purposes or for waste disposal,
3. Utilization of marine transportation
4. Direct dependence on the marine environment for raw material.
5. Labor availability in coastal population centers.

The wastewater from industries in coastal areas may pollute ecosystems. The impacts may range from relatively minor disturbances to major disruptions. The most important aspect to be taken into account to provide the sustainability is the accurate definition of the carrying capacity of the location. With regard to the environmental impact of industry in coastal areas the first priority is to focus upon the pollution of the coastal zone waters by industrial wastes. An indication of influences of various industries on the environmental parameters in the coastal zone is given in the connectivity matrix depicted in Fig. 1.

	Environmental parameters											
Development projects	Surface water hydrology	Surface water quality	Ground water hydrology	Air Quality	Land Quality (pollution)	Fisheries	Vegetation	Forests (Resources	Mineral Resources	Aesthetics	Socio-economic	Public health
Food processing	☆	✪	✪	★	☆	★	★	★		★	★	☆
Sugar refining	☆	✪	☆	★	☆	★		✪		★	★	☆
Pulp and paper	☆	✪	★	★	☆	✪		✪		★	★	☆
Fertilizer	★	✪	★	✪	☆		✪		★	★	★	★
Cement	☆	★	★	★	✪	★			✪	★	★	★
Tannery	☆	✪	☆	✪	★	✪				✪	★	☆
Pharmaceutical	☆	✪	☆	★	★	✪				☆	★	✪
Steel and iron manufacture	★	✪	★	✪		★			✪	★	★	★
Electroplating	★	✪	☆	☆	☆	★	✪			☆	★	☆
Petrochemical	☆	★	★	★	✪	★	☆		✪	★	★	★

✪ Significant impact; ★ Moderate to significant; ☆ Negligible

Figure 1 Potential environmental impacts of various categories of industry in the coastal zone (Carol, 1976)

2 Monitoring and Baseline

Two common types of information used in environmental management are (Clark, 19961):

(a) Baseline information that measures the environmental conditions and status of resources before a project is commenced and,

(b) Monitoring information that measures the changes, if any, that occurred after the project was built and operated. The statistical reliability of parameters used in baseline surveys and monitoring programs is a key factor with regard to the compatibility of these data.

The goal for a quantitative monitoring program is to detect, with statistical reliability, whether a significant environmental chance has occurred after intervention. Environmental impact predictions depend on understanding cause-effect relationships and the status and trends of environmental characteristics. As mentioned before, baseline studies establish the current state of ecosystems. These studies provide valuable sources of information for planning.

There are two major types of monitoring -strategic and tactical- as follow (Clark, 1996):

(a) The strategic level, before and after measurements of environmental parameters so that an "environmental audit" can be made of the project's effects. This of course requires that "benchmark" information be collected before the project starts to provide a statistically sound "baseline".

(b) The tactical level is the real time or oversight monitoring. The object is to monitor the operation day by day so as to detect any major negative impacts that may be occurring. If problems are detected operation is halted until the situation is remedied.

The monitoring studies can be carried out on water bodies, as well as land. *In situ* measurements for monitoring studies are traditional whereas in recent years remote sensing techniques are being widely used for this purpose in conjunction with the *in situ* measurements.

Land use identification by processing the satellite images, provides a baseline for the planning purposes of industrial development and for monitoring purposes during the operation period.

In the following sections two case studies for baseline establishment are discussed. The first one is from an environmental impact assessment study carried out by IMST, and the second one is from an EU project-AVICENNE Program in which IMST was one of the contributors.

2.1 Case Study: Environmental Impact Assessment Study For Göcek Tourism Complex and the Marina

Göcek coastal region, which covers 61300 ha of marine and 30000 ha of land areas, is located in the Fethiye Bay at the southwest part of Turkey (Fig. 2 & 3). There, a marina for 400 yachts and a tourism complex have been planned, which is expected to satisfy the accommodation and daily use needs with recreational and commercial aspects. As the area is within the "specially protected area" boundaries, an environmental impact assessment study was required for this project.

The project area and coastal activities are shown in Fig 4. The location of the planned tourism complex is 700-800 m far away from the center of the Göcek Town. There is an old "chromium rinsing plant" which is not in use any more on the project area (Fig. 4, 6).

The organization chart of the work group in accordance with their experiences is given in Chart 1 for this project. Approximately 40 people worked in this project, 20 of them being the experts.

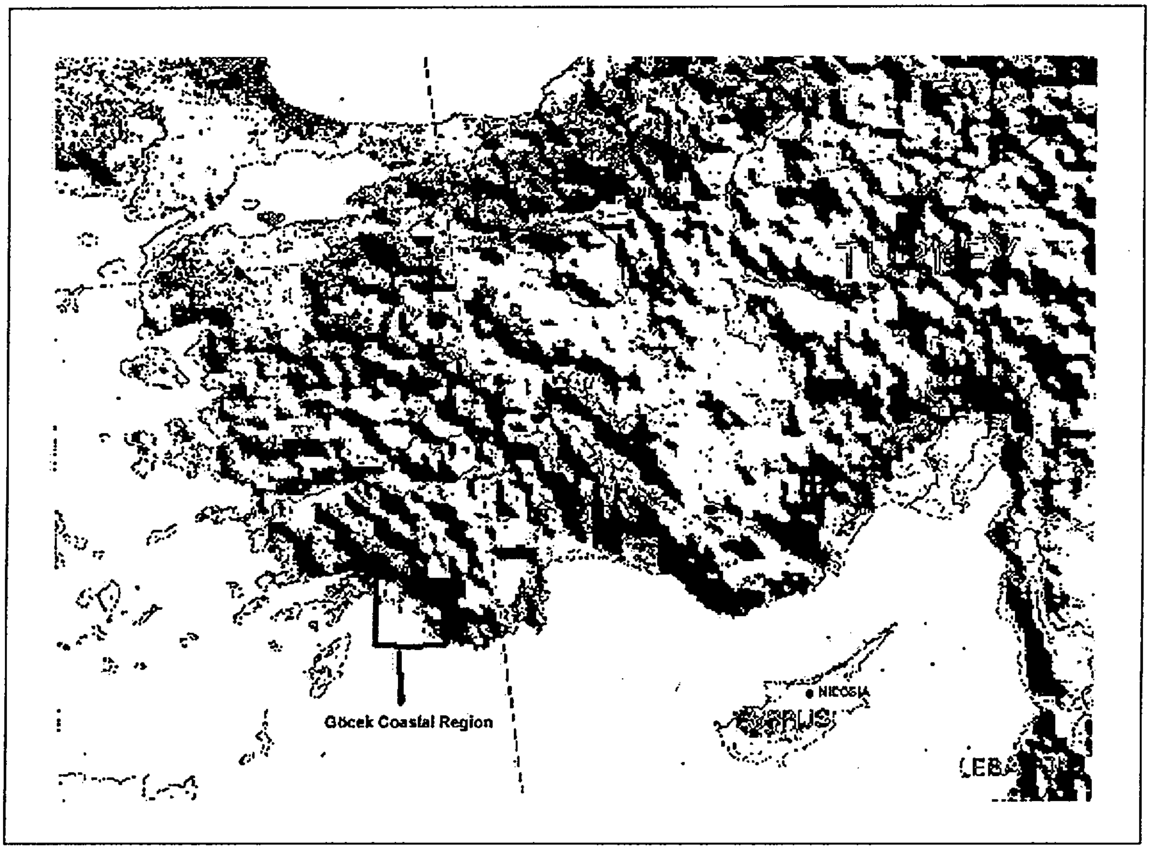


Figure 2 Location of Göcek Coastal Region along Turkish Coasts

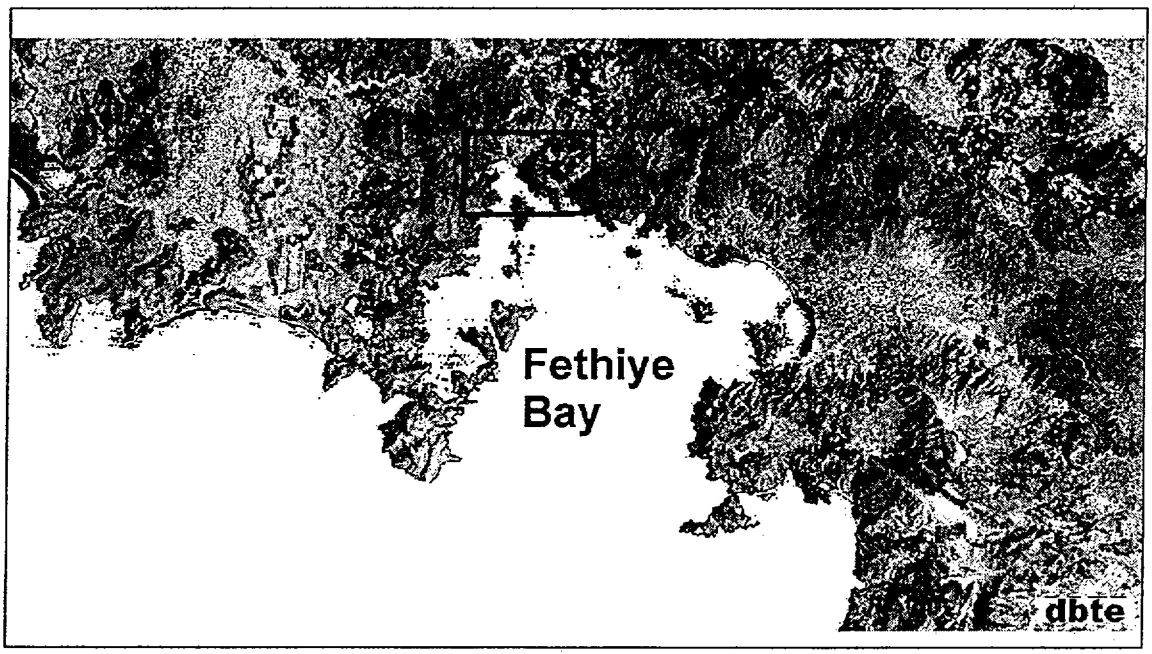


Figure 3 Location of Göcek Coastal Region in Fethiye Bay

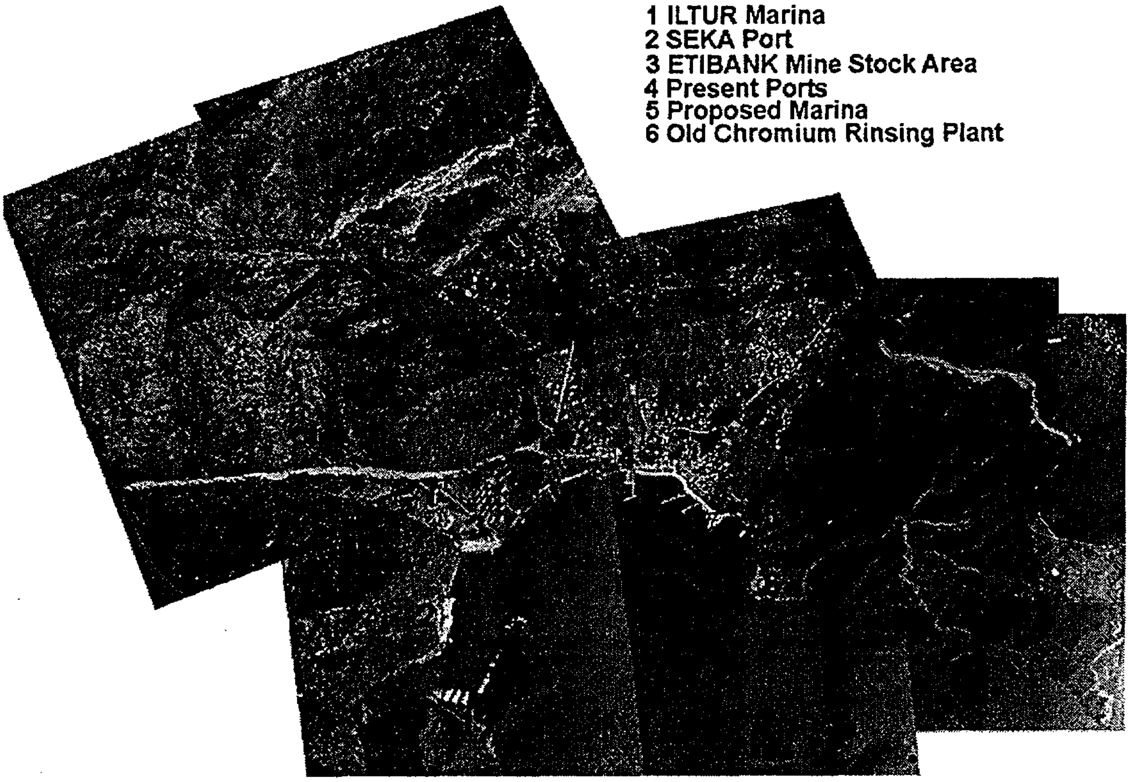
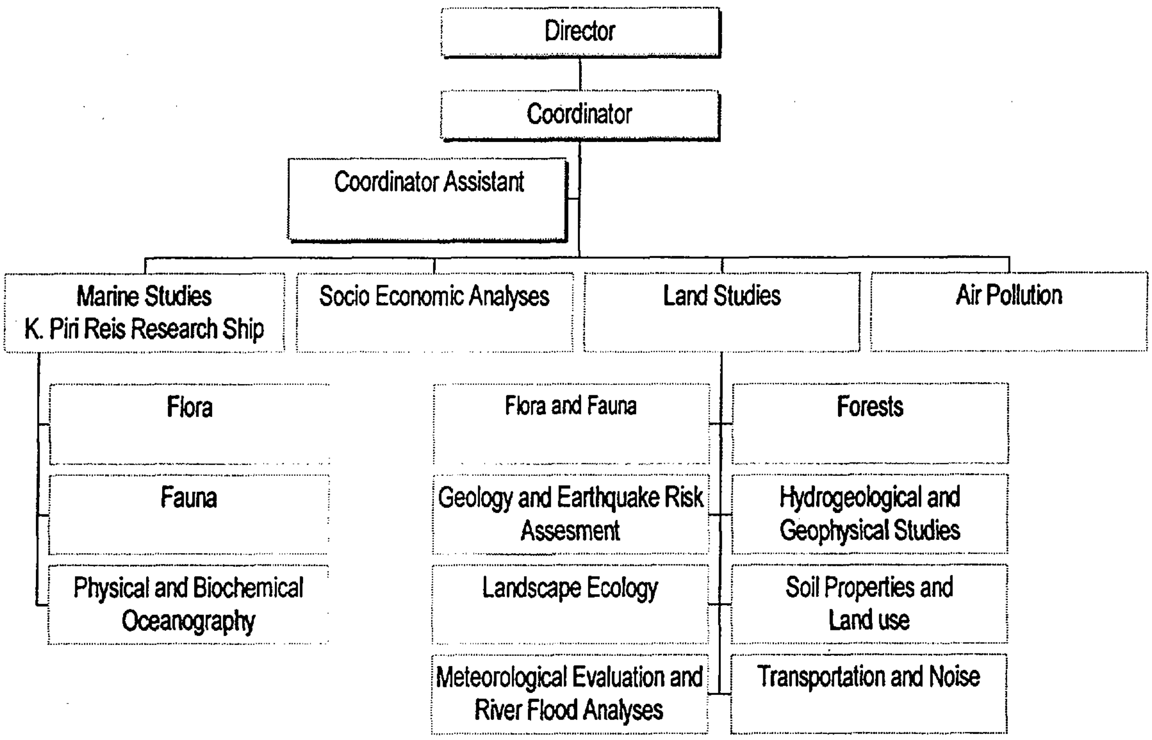


Figure 4 The project area and coastal activities along Göcek Coast

Chart 1 Organization Chart of the Working Groups in Göcek Project



The state of the environment has been assessed by *in situ* measurements carried out in three seasons (summer, winter, spring) in order to observe the seasonal variations in the ecosystem. 18 stations were selected on Göcek Bay to perform marine studies (Fig. 5). As can be seen on the organizational chart, marine studies were carried out in three groups; (1) flora, (2) fauna and (3) physical and biochemical oceanography. In the 1st and 2nd groups, the species were determined both for the pelagic and benthic parts of the marine environment. In the 3rd group following physical and biochemical parameters were measured.

Physical Parameters :	Biochemical Parameters:
♦ Temperature	♦ NO3-N
♦ Salinity	♦ NO2-N
♦ Density	♦ NH4-N
♦ Secci Disk	♦ PO4-P
	♦ Silicate
	♦ Chlorophyll α

Also, sediment samples from some of the stations were taken in order to analyze the chromium content.

Land based investigations were carried out in 8 groups as seen in the organization chart. A group evaluated the state of the terrestrial ecosystem, whereas another expert carried out studies on the state of the forest in the project area. The soil expert gave a special attention to the chrome rinsing plant site (Fig 7). Test bores determined geological, geophysical and, hydrogeological properties of the area.

At the end of this study a very comprehensive report was prepared in which the existing state of the environment for the project area was established. This baseline constituted the initial condition upon which the possible impacts of the project were assessed.

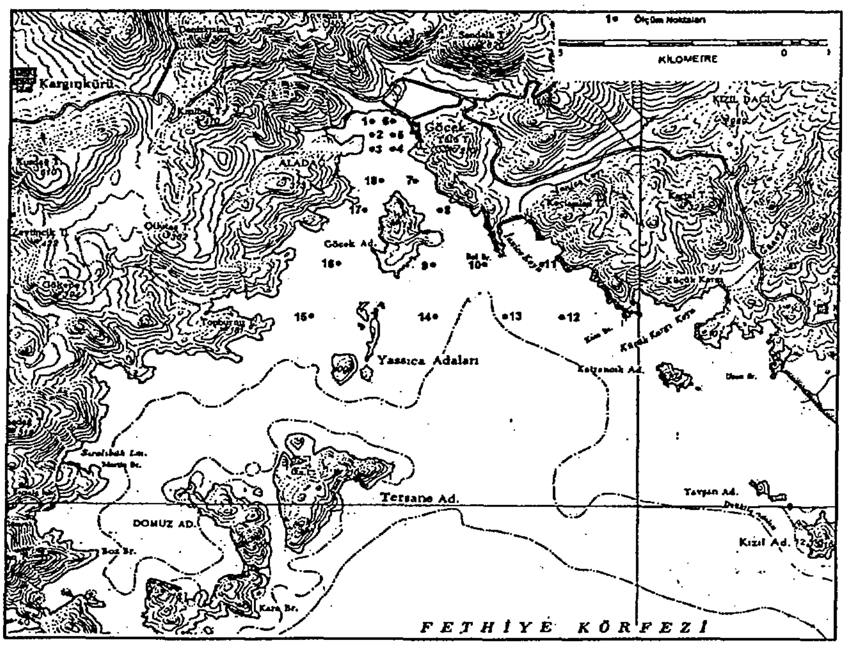


Figure 5 Measurement Stations on Göcek Bay

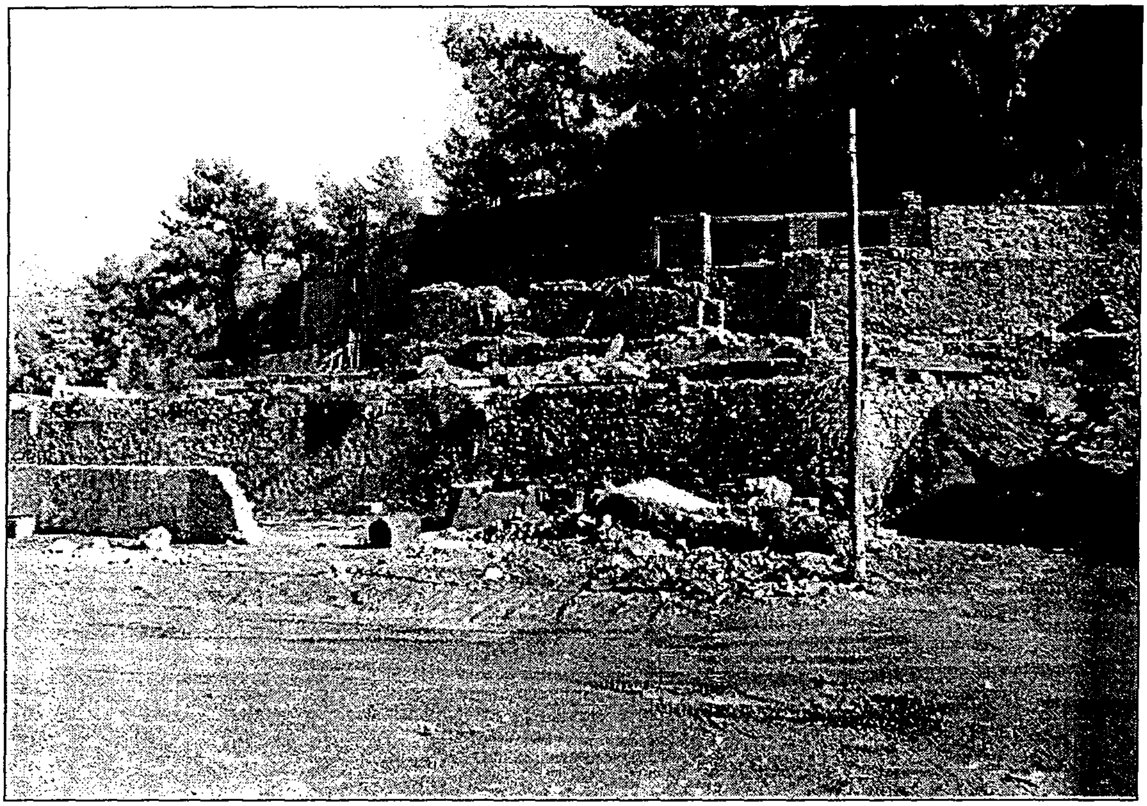


Figure 6 The Old Chromium Rinsing Plant on the Project Area

Figure 7 Soil View from Chromium Rinsing Pool

2.2 Case Study: Land use Identification by Satellite Remote Sensing in Nif Basin

Remote sensing techniques are widely used to determine the land use patterns in recent years. With these techniques, it is possible to detect changes in the land use patterns both qualitatively and quantitatively.

For more than 20 years, LANDSAT series satellites have been recording picture of Earth's surface. LANDSAT, the first satellite in this series was launched in 1972 and it literally changed the way we looked at our planet. The picture of the Earth's surface from LANDSAT series satellites gave scientists in many disciplines new opportunities to understand the complex systems of Earth. Where normally 100 aerial photographs and many months or years would be necessary to assemble and analyze a scene 185 by 185 kilometers in size; LANDSAT could cover the same area in just a single picture. The analysis of the picture could be accomplished in just a few days or weeks. Furthermore, LANDSAT data was timely- especially useful for agricultural and environmental studies.

Since the first LANDSAT launch, scientists and technicians from more than 130 countries have used LANDSAT data and images to know and understand the resources and environment of their portions of the Earth.

This study is a part of an EU Project-AVICENNE Program (Mediterranean non-point sources of pollution). In this EU funded project, an approach has been developed to estimate the space/time distribution of non-point (diffused) pollution originating from small watersheds that influence the coastal water quality. The approach is based upon Remote Sensing (RS), Geographical Information Systems (GIS) and Hydrological Modeling (HM). A semi-automated land classification according to the CORINE system has been used to produce a land cover digital map of the watershed from LANDSAT images. Non-point source pollution loads from various sub-segments of the watershed have been estimated according to this land use classification. Finally a hydrological model for non-point source pollutants has been used for the purpose of routing the specified pollutants through the drainage basin.

Institute of Marine Sciences and Technology in Izmir, integrated satellite remote sensing and image processing methods together with capabilities of geographical information systems (GIS) technologies on Nif Basin for application of CORINE land cover.

The Nif Basin is a sub-watershed of the Gediz River in the Aegean region of Turkey (Fig. 8). The basin boundary and the watercourses in the basin were defined by using 1:100,000 scaled topographic maps (General Administration of Maps, 1982). The agricultural land use practices were defined by 1:100,000 scaled soil maps and approximate figures of these land use practices were assessed after several visits to relevant state institutions as well as from the reports on Gediz Watershed.

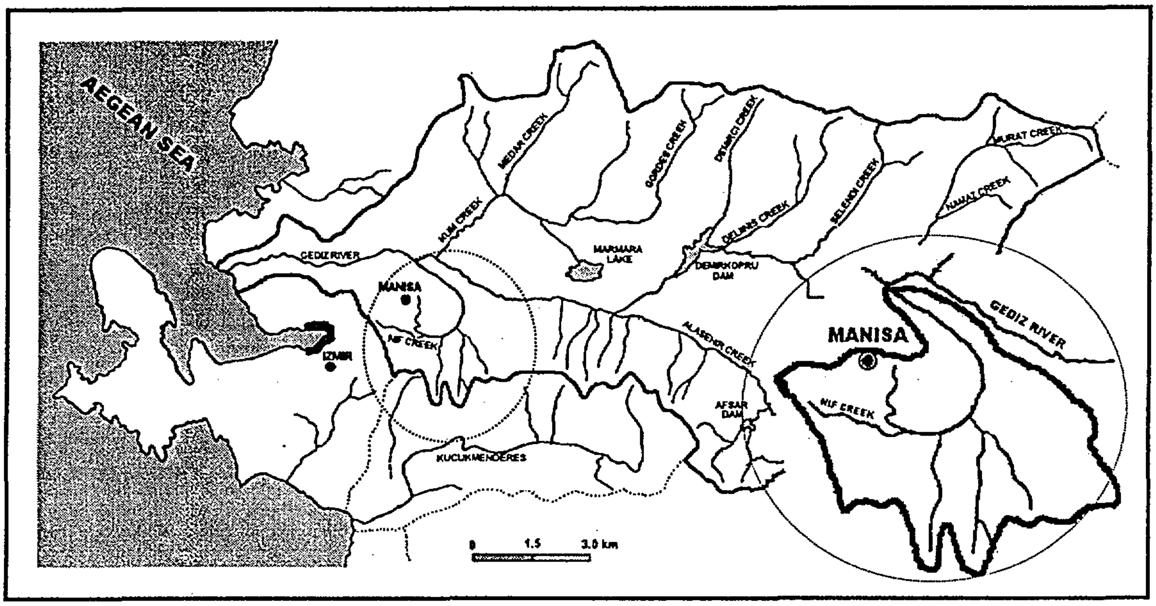


Figure 8 Location of Nif Basin

In this application, LANDSAT 4 MSS (Path 188 Row 33 Date 05.06.1987) 4 Band Full Scene Images (Project: Space Object Marcator, Resampling: Cubic Convolution) were obtained as ERDAS LAN file format. The Band combination of LANDSAT MSS data, 7,5,4 (RGB), offers enhanced discrimination of land-water boundaries and highlights important details. Since there was only one image available, multi-temporal analyses were not performed.

The MSS covers a 185 km swath width in four wavelength bands: two in the visible spectrum and two in the reflected infrared. These bands are designated as channel numbers 4, 5, 6, and 7.

Bands	Band Characteristics
4	Visible Green, 0.50-0.60 Fm. Corresponds to the green reflectance of healthy vegetation. Also useful for cultural feature identification.
5	Visible Red, 0.6-0.7 Fm. Useful for discriminating between many plant species. It is also useful for determining soil boundary and geological boundary delineation as well as cultural features.
6	Reflective-infrared, 0.7-0.80 Fm. This band is especially responsive to the amount of vegetation biomass present in a scene. It is useful for crop identification and emphasizes soil/crop and land/water contrasts.
7	Near-infrared, 0.80-1.10 Fm. Important for NDVI, topographic mapping.

The image values need to be modified to highlight information within the image by image enhancement methods. In many applications, only the first few bands will contain significant data. Principal Component Analysis (PCA) was carried out to reduce the number of bands prior to classification. Spectral enhancement technique was used to make certain features more visible in an image by bringing out the contrast.

The variation of environmental data characteristics (availability, definitions, measurement techniques etc.) causes difficulties to carry out comparisons between regions. In response to this need, European Community decided to undertake the CORINE Program (COoRdination, INformation, Environment) to gather, coordinate, and ensure the consistency of information on the state of the environment and natural resources. In this project CORINE land cover nomenclature was used (Appendix 1).

Supervised classification was carried out in this respect. Supervised classification requires three steps: the creation of training sites, the creation of signature files from the training sites and then the application of a classification procedure to the image bands using the signatures created from the training sites. A training site is the geographical area represented by the pixel in a sample. Training sites are the examples of informational classes such as agricultural areas, forests or water bodies, much like categories on a map. The categories are then characterized across all bands to create a signature or spectral response pattern for each informational class. Finally, the signatures for each informational class are used to classify the full image by determining the most likely class for each individual pixel in the image.

For each band (7,5,4) training sites were created. Total number of the training sites was 26. They were previously identified with the use of ground truth data, Baseline Topographic Maps 1:100.000 and 1:25.000, Forestry Maps 1:100.000. Locations of the samples were digitized from the screen.

After the evaluation of the reliability of the signatures, an input LAN file was classified using maximum likelihood/Bayesian decision rule for primary multispectral classification.

From the Level 2 and 3 of the CORINE Land Cover Nomenclature, 6 classes were determined at the Nif Basin. Due to the heterogeneity in land use it was not possible to use CORINE classification directly as a model input so a reclassification was carried out as an intermediate step. It was necessary to convert this classified ERDAS GIS file to the IDRISI format for practical reasons. Boundaries and streams of this basin were scanned and converted into a digital environment.

It is very important to georeference all spatial data files in Geographical Information Systems (GIS). Georeferencing refers to the location of a layer or coverage in space as defined by a known coordinate referring system. Therefore, the raster file, which contains digitized boundaries and streams, was converted to the coordinate system of the remotely sensed image by IDRISI.

The produced land use image shows a heterogeneous structure. For this reason, without destroying the general structure, each of the small land use categories was merged with similar neighboring land use categories. Therefore, the image becomes more homogeneous and may be more effectively used as input for any model. These procedures were conducted by using the on screen digitizing capabilities of the IDRISI.

Figure 9 Raw image

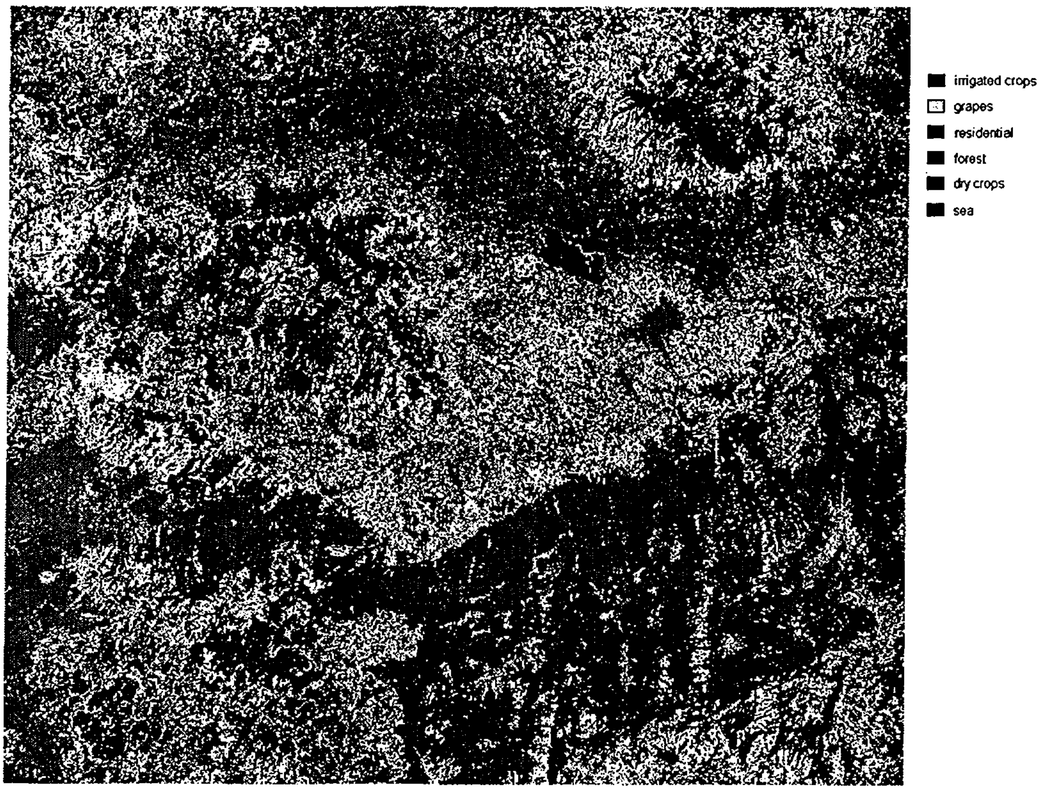


Figure 10 Land use patterns in accordance with CORINE classification

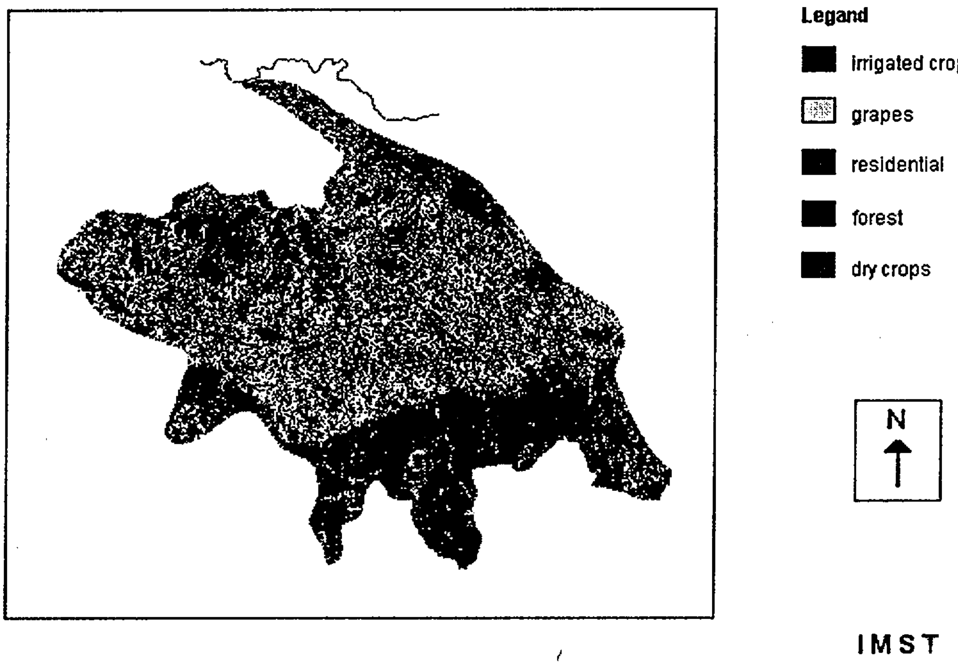


Figure 11 Land use patterns in accordance with CORINE classification in Nif Basin

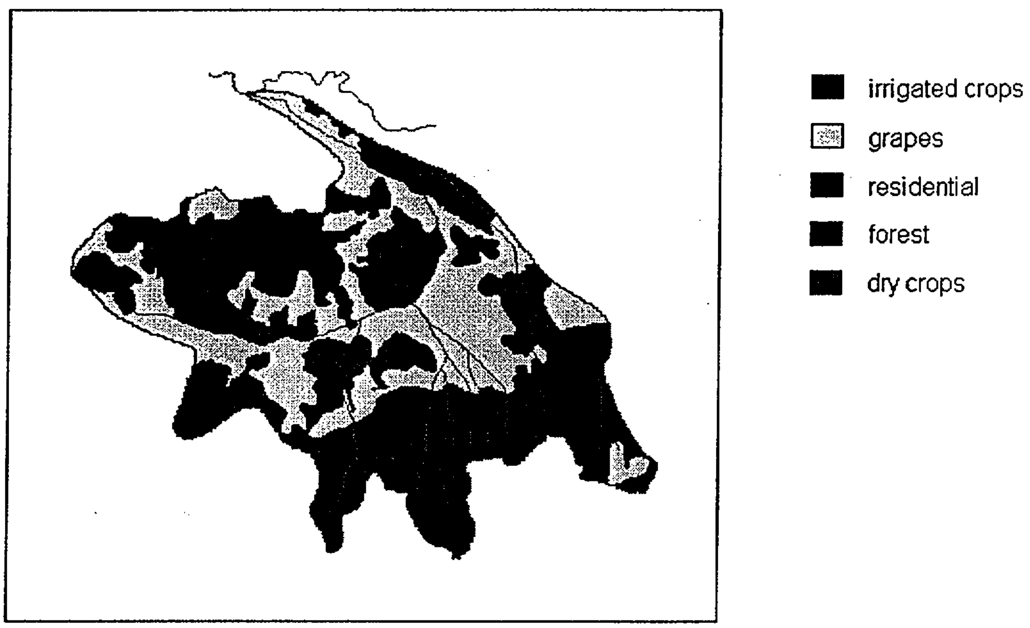


Figure 12 Land use patterns in Nif Basin

3 Conclusion

The first aim for a robust monitoring system is to establish an environmental baseline. There are two tools for baseline establishment and monitoring systems (a) *in situ* measurements (b) remote sensing techniques.

When an activity (especially an industrial activity) is planned, which is thought to have impacts on the environment, a baseline establishment study for the location should be carried out in order to investigate the state of the ecosystem for future comparisons. This investigation should include seasonal variations of the ecosystem, as well as identification of land use patterns on the area.

In situ measurements for several environmental parameters should be carried out seasonally as in case study 1. The environmental parameters should be selected in accordance with the construction and operation impacts for that activity. For such a marina village development project, air and water quality parameters together with soil properties are measured, as well as flora and fauna, which are carried out both for sea and land in three seasons.

The state of the ecosystem for the project area was established so that if the measurements would be carried out during the operation of the activity, one might compare the after operation state of the environment with the before construction one.

The land use patterns for this area were identified from the digital aerial photographs provided by IMST. Aerial photographs for this case was enough for the purpose as the project area was small (approximately 20 ha). When application of remote sensing is considered for larger areas like Nif Basin (1000 km^2), land use identification by aerial photography becomes unrealistic due to the huge amount of images, which have to be received and processed in a reasonable time and at a reasonable cost. LANDSAT MSS images, each having 80x80 m spatial resolution, and 185 km swath width, were used for land use identification in Nif Basin, according to CORINE nomenclature.

Land use identification in Nif Basin is based on agricultural patterns for the project purposes, so all artificial sites are considered as residential. However, it is possible to identify industrial land use patterns on LANDSAT images in accordance with the CORINE nomenclature (Appendix 1).

Satellite imagery is not only used for baseline establishment studies. It is also useful for the monitoring and planning purposes. Satellite images can be obtained periodically and by image processing techniques, it is possible to detect temporal changes on environmental conditions.

APPENDIX 1

CORINE LAND COVER NOMENCLATURE

Primary Division	Secondary Division	Tertiary Division	Nomenclature Definitions
1.			***Artificial surfaces***
	1.1.		Urban fabric
		1.1.1.	Continuous urban fabric
		1.1.2.	Discontinuous urban fabric
	1.2.		Industrial, commercial and transport units
		1.2.1.	Industrial or commercial units
		1.2.2.	Road and rail networks and associated land
		1.2.3.	Port areas
		1.2.4.	Airports
	1.3.		Mine, dump and construction sites
		1.3.1.	Mineral extraction sites
		1.3.2.	Dump sites
		1.3.3.	Construction sites
	1.4.		Artificial, non-agricultural vegetated areas
		1.4.1.	Green urban areas
		1.4.2.	Sport and leisure facilities
2.			***Agricultural areas***
	2.1.		Arable land
		2.1.1.	Non-irrigated arable land
		2.1.2.	Permanently irrigated land
		2.1.3.	Rice fields
	2.2.		Permanent crops
		2.2.1.	Vineyards
		2.2.2.	Fruit trees and berry plantations
		2.2.3.	Olive groves
	2.3.		Pastures
		2.3.1.	Pastures
	2.4.		Heterogeneous agricultural areas
		2.4.1.	Annual crops associated with permanent crops
		2.4.2.	Complex cultivation patterns
		2.4.3.	Land principally occupied by agriculture, with significant areas of natural vegetation
		2.4.4.	Agro-forestry areas
3.			***Forests and semi-natural areas***
	3.1.		Forests
		3.1.1.	Broad-leaved forest
		3.1.2.	Coniferous forest
		3.1.3.	Mixed forest
	3.2.		Shrub and/or herbaceous vegetation associations
		3.2.1.	Natural grassland
		3.2.2.	Moors and heathland

INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20 November 1998; Izmir-Turkey

'Hot spots' in Lebanon

H.H.Kouyoumjian; National Centre for Marine Sciences, Lebanon

Industrial development and the associated problems that form the subject matter of this meeting should be looked into in the following institutional and legal framework in Lebanon. This framework became well recognized after the war, and all remedial action now focuses on these in order to manage the environmental problems that the country faces during this reconstruction phase adequately.

The highlights of this framework could be summarized as follows:

- Increased environmental awareness
- Confusion between balanced and parallel development
- Lack of national or regional land use plans
- Lack of national or regional planning authority
- Under-utilized, understaffed and under equipped operational and research units
- Outdated and inconsistent environmental laws and regulations
- Overlapping and uncoordinated environmental management responsibilities
- Severe lack of enforcement of environmental regulations
- Failure to establish EIA requirements and procedures
- Promotion of private investment in traditional public sectors
- Haphazard public participation in decision making and no coordination in action led by NGO's

Much has been accomplished over the past 3-4 years in order to institutionalize some of these concerns and explore adequate solutions to the above mentioned shortcomings. A description of such action is outside the scope of this brief presentation; however, I wish to mention that the establishment of the Ministry of Environment was one tangible outcome that is expected to go a long way in order to find lasting solutions to these chronic problems. In this presentation I shall only focus on the coastal stretch which is about 220 km long along a north-south axis.

A recent regional environment assessment report on the coastal zone of Lebanon (ECODIT-IAURIF, 1997) has identified numerous hot spots of which 4 are of major significance. The discussion below briefly highlights the current environmental and land use situation and projects future development scenarios for each of the 4 hot spots:

1. TRIPOLI'S NORTHERN COAST

This zone around the second major city of Lebanon has experienced loss of green space over the past decade. Although urbanization is generally quite compact, there is a tendency for ribbon development along major roads leading to the villages surrounding the metropolis. There is widespread urban sprawl along all roads.

The industrial zone in this area is amongst the largest in the country (oil refinery, power plant etc). The recent rehabilitation of the port has led to trapping of pollutants along the northern shores of the city. The major river in this area Nahr Abu Ali is a concrete canal inside the urban area that carries domestic waste, sewage and industrial effluents including slaughterhouse remains. Relatively abandoned trees and olive plantations that need protection and conservation surround the area.

An environmental planning and management scenario should consider the following:

1. The need for an urban plan and an environmental management plan.
2. A landscaping plan providing for large green corridors and green spaces, and the need to regenerate the natural vegetation.
3. Ribbon urban development should be prevented along the highway thereby preserving olive groves and the natural landscapes.
4. The need to establish a local coastal land use plan.
5. The need to preserve public access to the beaches.
6. The need to conduct EIA for major industries and infrastructure works and implementation of necessary mitigation measures.
7. The need to implement measures to control and prevent air, freshwater, and seawater pollution.
8. The need to rehabilitate the mouth of the Nahr Abu Ali
9. The need to rehabilitate the current dump site into open public space.
10. The need to reinforce the protection of the only marine nature reserve the Nakhl Islands off Tripoli.

2. RAS CHEQUA PROMOMTPRY

At stake are the preservation of the only natural promontory between Beirut and the northern city of Tripoli. This is a rocky promontory that has still kept most of its natural beauty and natural pristine characteristics. It is covered by typical Mediterranean garrigues and is an important stopover for migratory birds.

Environmental planning and management scenario

1. The need to create a geo-marine park with well-defined management plans.
2. The need to control the urbanization process.
3. The need to prepare a master plan in order to coordinate and control the operation of quarries and the extension of existing industrial sites.

4. Measures to control and prevent air, freshwater and seawater pollution from the existing cement and petrochemical industries.
5. The need to conduct EIA for major industries.

About 20 km to the south of this spot the Nahr Ibrahim (Adonis) valley is an area of significant historic and cultural importance that has suffered as a result of quarrying and the siting of industries along its course that has considerably damaged this zone. Industrial development in this area should be stopped and green measures introduced by the existing industries.

3. DAMOUR COASTAL PLAIN

This is the last coastal stretch near Beirut, which is relatively non-urbanized, and offers a green buffer zone between Beirut and the southern city of Saida. The zone is a narrow fertile agricultural area covered with orchards extending all the way to the coast.

The Nahr Damour valley is one of the few untouched valleys and is covered with rich and dense vegetation. The mouth of the river, however, has been degraded by the construction of the new coastal highway and a large quarry. In the hinterland the gentle slopes of the Barouk mountains are covered by guarrigues and relatively large forests.

Environmental planning and management scenario

1. The need to have a detailed land use plan in order to preserve the coastal plain.
2. The need to control urbanization and direct it to the east of the highway.
3. The need to control urban sprawl, ribbon development, and touristic developments, while preserving public access to the beaches.
4. The need to adopt environmentally sound agricultural practices using less pesticide and conserving water resources.
5. The needs to introduce legislation in order to protect the river and declare part of the valley a nature reserve.
6. The needs to rehabilitate the river mouths and reforest part of the mountain thus increasing water resources.

4. TYRE'S SOUTHERN COAST

This zone at the extreme south of Lebanon is the last pristine stretch of coastal zone comprising from beaches, dunes, wetland, rocky headlands etc. Another characteristic of this sensitive area is the extent and integrity of the agricultural plains. This area also has the second most significant water source in Lebanon, which has been continuously exploited since ancient times. The extensive sandy beaches run all the way to the southern border.

Environmental planning and management scenario

1. The need to prepare a master plan for the development of the urban areas, and identifying the historic and archaeological areas, beaches etc. Urban growth to be directed away from coastal agricultural plains.

2. The need to avoid additional coastal urbanization by directed coastal highways inland.
3. The need to respect public aright of access to the beaches, except areas designated as nature reserves.
4. Stop sand extraction and preserve coastal terraces, sand dunes etc.
5. Preserve the biodiversity and the authentic landscape untouched since biblical times.

The above-mentioned is a brief discussion of some of the hot spots and what should be done in order to preserve and conserve these sites from the dangers of pollution, urbanization and development. There are several other important spots as well, but a detailed study of all these falls outside the scope of this brief presentation.

The Role of Biomonitoring and Bioindicators

Hüseyin A. BENLI and Erkan DEMIRKURT
Institute of Marine Sciences and Technology
Haydar Aliev Bulvarı, Inciraltı-Izmir-TURKEY

What is the effect of the continually increasing industrial activity from both artificial and natural sources in the 20th century, especially the effect of the chemicals on coastal regions? Having noticed this question the expression "Marine Pollution" came into being and the term marine pollution monitoring and observation studies began to be heard. In short, effects on the environment, whether direct or indirect of an activity's contaminants can be explained by constant measurement (UNEP/FAO/IAEA, 1993). One must not consider here that the expression "contamination" has the same meaning as pollution. Because, owing to its release into the environment, the contaminating material or energy causes background levels to increase. The result of either increased pollution or increased contamination is adverse or harmful to the marine environment..

The marine pollution is a common problem of the world nations. The various contaminants enter the marine environment the continuously increase the marine pollution. The observation of this pollution initiated the development of new strategies (Viarengo & Canesi, 1991):

- As in chemical observation, in the different matrices of the marine ecosystem (sea water, sediment and organisms), the pollution levels (metals, hydrocarbons, pesticides etc.), can be detected,
- In polluted regions the harmful effects of pollution on living organisms, and their known biologic effects can be observed.

In the light of these strategies, in the Mediterranean countries, the Mediterranean Pollution Observation Programme (Med-Pol) was brought into being. This program, as mentioned above, includes the study of sea water, sediment and especially pollutants such as heavy metals and hydrocarbons in the biota (Gabrialides, 1991). As the result of this type of chemical observation, the quality of the abiotic environment can be determined. However it is also important to know the physiologic responses shown by organisms to toxic materials such as contaminating metals, and their effect on organisms. This is why the concept of biomonitoring appears and it is an important support in the pollution study programme. The physiological responses shown by living organisms to whatever stress they are exposed to constitutes the basic principle of the biomonitoring programme. These responses were fist discussed at the ICES meeting in 1979. Development of these techniques and Med-Pol's scope and use is being determined and improved continuously (UNEP/FAO/IOC 1992). In biomonitoring studies, because the condition of the environment is placed at the centre, organism's reaction to toxic pollutants such as heavy metals can be measured on a sublethal level. This facilitates finding the correct solutions to the pollution problem.

According to Widdows (1985), physiological responses used have to comply with the following criteria:

- They should be sensitive to environmental stress and pollution and have a large scope for response throughout the rangefrom optimal to lethal conditions,
- They should reflect a quntitative or otherwise predictable relationship with the pollutant,
- They should have a relatively short response time, in the order of hours to weeks, so that pollution impact may be detected in its incipient stages,
- They should represented non-specific (general) responses to the sum of environmental stimuli, thus providing measurements of the overall impact of environmental cahange and complementing the more contaminant-specific responses at the cellular level,
- They should be measurable with precision and with a high "signal to noise" ratio so that the effect of pollution may be detected above the "noise" of natural variability,
- They should have ecological significance and show, or convincingly indicate the relationship to an adverse or damaging effect on growth, reproduction or the survival of the individual and the population.

The physiological responses, which can be defined as the "Stress Indices" in biomonitoring, include the above criteria. According to Viarengo and Canesi (1991), stress indices may be categorized as:

- General: which reveal a stress syndrome characteristic of the physiological response to a wide range of environmental stressors, including contaminants and natural physical and biological factors (variation of temperature, oxygen, salinity, food availability, etc.).
- Specific: which reflect responses to particular classes of contaminants (heavymetals, organic xenobiotic compounds, etc.), scope for Growth,

Histo-pathological and cellular alterations, general stres indices and the level of metallothionein, as an indicator of the response to heavy metal pollution; the mixed function oxygenase (MFO) activity, as an indicator of the response to organic xenobiotic pollution can be accepted as a specific indices (Bayne 1986; Viarengo and Canesi 1991).

The outcome of research now being done in biomonitoring to transform this into a routine condition will take time. As the result of research now being undertaken, new topics can be added to the stress indices being discussed and can be adapted to these fields.

In biomonitoring studies, the concept bioindicator emerges. In this sort of work, the choice of bioindicator (indicator organism), is rather important. The indicator organism selected for monitoring the chemical and biological effects of pollution should possess a number of important attributes:

- a wide geographic distribution,
- dominant member of coastal and eustarine communites,
- accumulate contaminants in their body tissues,
- responsive to many environmental pollutants, but do not show a prolonged handling stress.

In addition, a comprehensive knowledge of the test organism's basic biology and its response to a wide range of intrinsic factors and extrinsic factors is important at all stages of a monitoring programme (Widdows 1985). In biomonitoring programmes throughout the world, bivalves, particularly mussels are used as a bioindicator or indicator organism because they meet the all the characteristics defined above. They are sedentary and are therefore better than mobile species as integrators of chemical contamination in a given area, although, they are suspension-feeders that pump large volumes of water and concentrate many chemicals in their tissues (Widdows and Donkin 1992).

Apart from bivalve, members of the crustacea and some demersal fishes are also used by researchers as bioindicator (Hinton and Lauren 1992; Moore and Evans 1992; Moore et al., 1994). On the other hand, especially in the marine environment, metal binding proteins can be used in the determination of the biological effect of heavy metal pollutants (Viarengo et al., 1987; Viarengo and Canesi 1991; George and Olsson 1994).

The great importance of biomonitoring in the marine environment is that the problems of pollution and its effects on biota can be more quickly determined. In any case, bioindicator or indicator organisms are an inseparable part of this type of study. As a result, in biomonitoring work the improvement of techniques will be able to be used and will be more helpful in our ability to analyse the biological effects of pollution.

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Dealing with 'hot spots' - some practical examples

Round table discussion led by Mr. E. Feoli and Mr. L.F. Cassar
ICS/UNIDO, Trieste

Inputs by: Mr. A. Chouiki, IMS, Izmir;
Mr. D. Ouazar, Ecole Mohammadia d'Ingeniers, Rabat; and
Mr. N. Taspinar, IMST, Izmir.

Integrated Coastal Zone Management - Morocco

Study and Pilot Area: Safi

Mr. D. Ouazar
Ecole Mohammadia d'Ingeniers, Rabat

Introduction

In the wake of the Earth Summit, there has been an explosion of international integrated coastal zone management (ICZM) initiatives along with a commensurate increase in international research programs, training courses and networks. However, in developing countries, very few are expected to be established in the near future.

Geographic information Systems and the rapidly increasing availability of data from environmental satellites, supplementing surface data, have changed tremendously the way we can build environmental information systems and their related decision support for possible assessment, decision and monitoring. In addition, new information and telecommunication technology for data acquisition and global distance learning programs, are yet another powerful tool which when used in conjunction to the above mentioned tools, will greatly enhance any scientific program.

The United Nations Conference on Environment and Development outlined an ambitious agenda for integrated management and sustainable development of coastal and marine areas. Agenda 21, Chapter 17 calls for coastal nations to provide human resource development and training (17.6(k)). In addition, capacity building and human resource development are considered the major means of implementation:

"17.15 Coastal States should promote and facilitate the organization of education and training in integrated coastal and marine management and sustainable development..."

"17.16 ...capacity building should be included in bilateral and multilateral development cooperation. Coastal States may consider, inter alia, (f) Promoting and facilitating human resource development and education..." (UNCED, 1992) to develop and share training materials and build ICM training and educational capacity.

In developing countries, donors and national governments are willing to invest in intensive training of working professionals as a short-term answer to meeting manpower needs.

The explosion of ICZM programs in developing countries, accelerated by Agenda 21, has created an immediate demand for ICZM professionals. In the short term, this demand is being met with increased training programs targeted at regional and international audiences. In addition, ICZM training is also exploding at the local and national level in many countries. It can be argued that the explosion of training initiatives directed at developing countries is partially the result of local universities not providing graduates with the appropriate knowledge and skills required to fill new positions as integrated coastal planners and managers. In all fairness, university degree programs cannot be established overnight. This emphasizes the need to increase the capacity of a university, including faculty development, to create ICM educational programs in developing countries for the long term. Until such programs are established, demand for skilled ICM practitioners in developing countries will continue to be met through short-term training programs, on-the-job training, and by university graduates from developed countries.

A number of issues need to be considered including:

- Training of trainers and faculty development
- Materials development to support training and educational programs
- Implications of a changing and evolving ICM paradigm and associated set of tools
- Linkages between training programs and emerging educational degree programs
- The role of evolving communication and computer-based learning technology
- Coordination among current training and educational providers to maximize financial investments in ICZM training

A good project has to include:

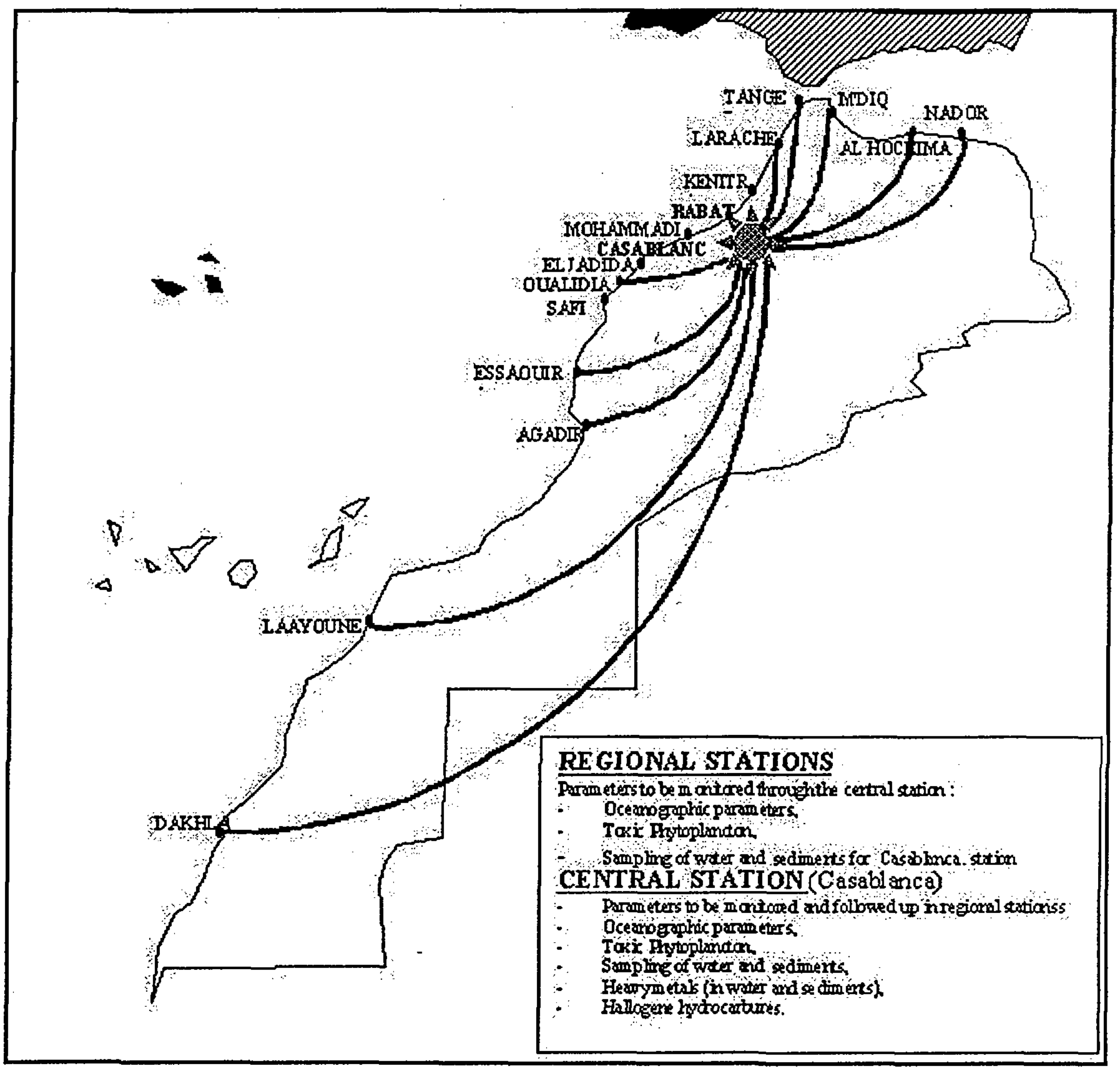
- the establishment of a preliminary definition for national coastal zone boundaries for land management and policy decisions;
- the preparation of national ICZM assessment reports;
- the preparation of regional ICZM synthesis reports;
- the identification, selection and preparation of ICZM pilot project proposals;

In this proposal, we focus on a demonstration project in a developing country to be extended for a possible regional program.

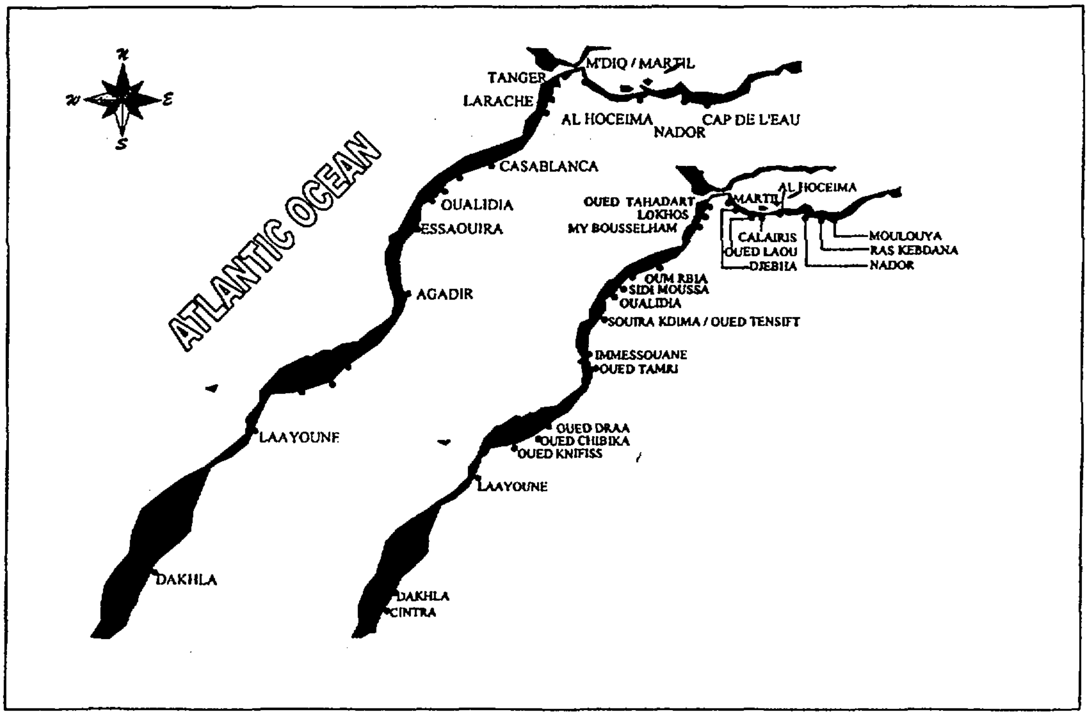
BACKGROUND RATIONALE AND CONTEXT

Morocco proud of its 3,500 km coastal area, is nowadays suffering a lot from the increased industrial, agricultural and urban pollution. The Big Casablanca region extending from Kenitra to Safi is concentrating more than 80% of the Moroccan Industry (chemicals, oil, phosphates, energy,...). This has led to numerous problems as described below.

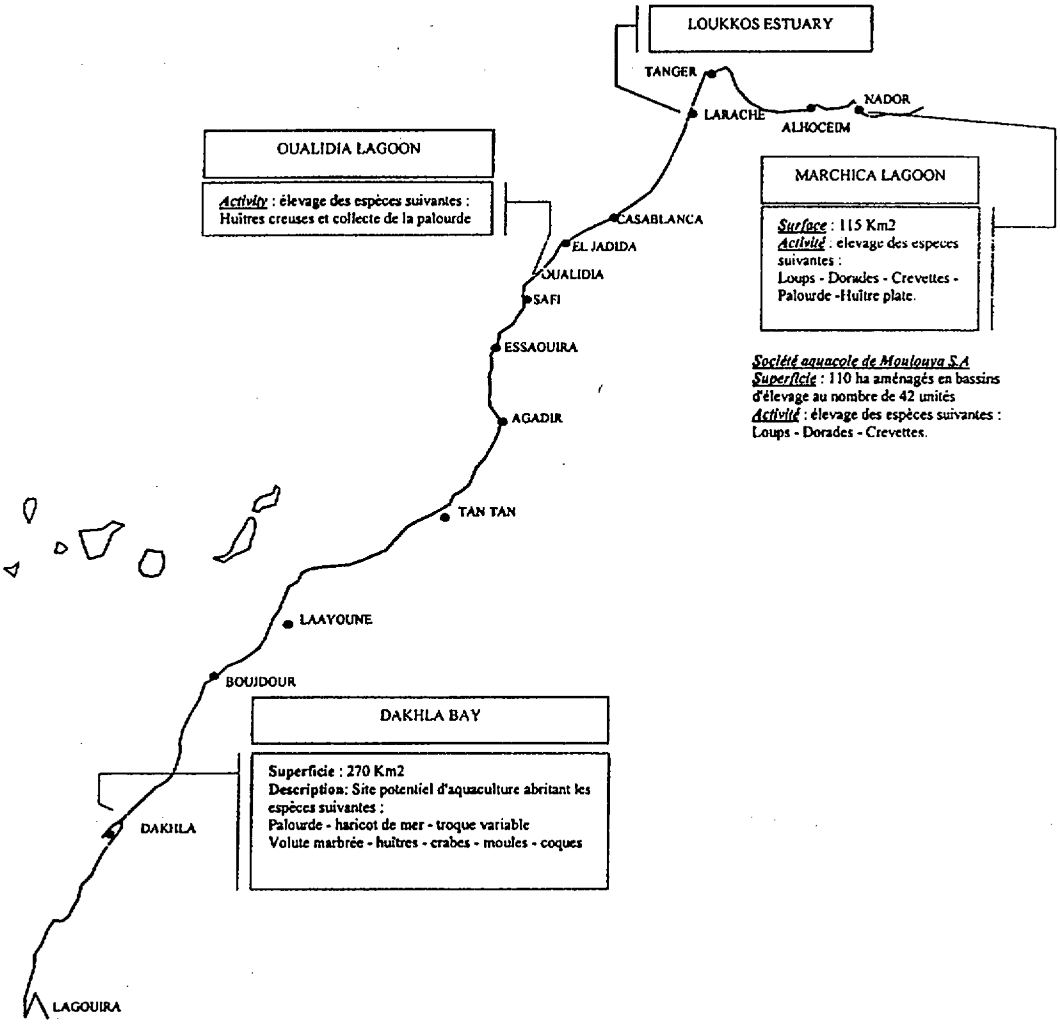
LITTORAL MONITORING NETWORK

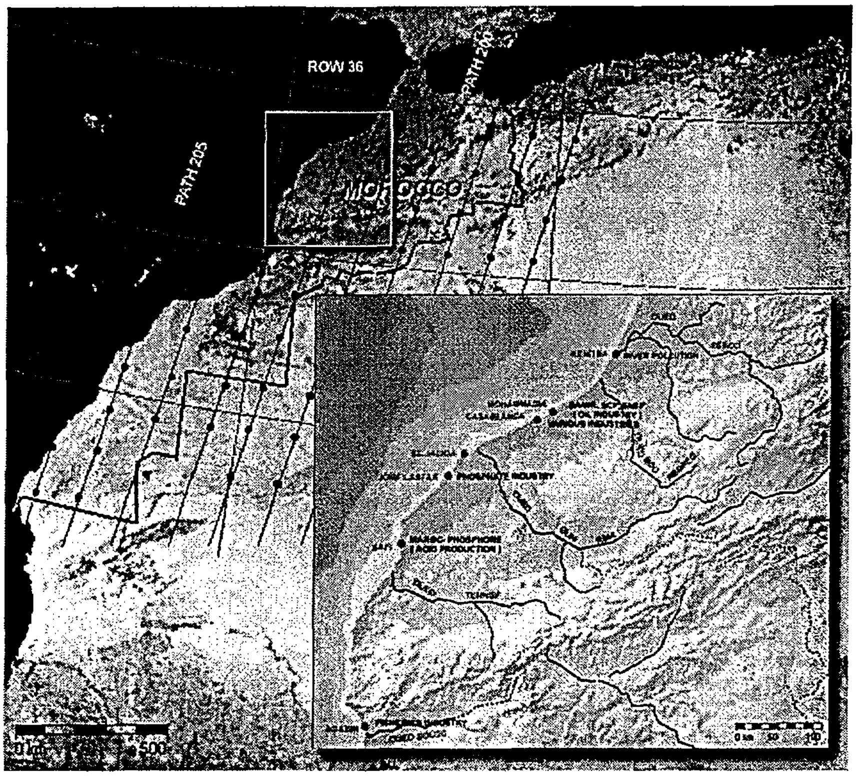


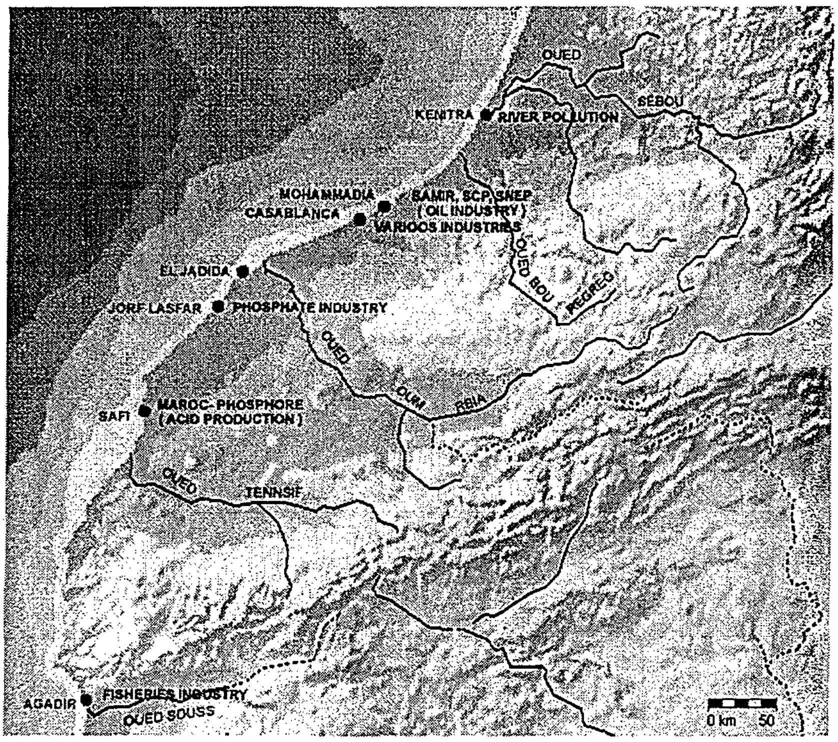
MONITORING NETWORK- STATIONS AND AQUACULTURE POTENTIAL SITES



AQUACULTURE POTENTIAL SITES




ROW 36
PATH 205
Morocco
0 km
500


OUED
SEBOU
KENITRA
RIVER POLLUTION
MOHAMMADIA
BAMIR, SCP, SNEP
(OIL INDUSTRY)
CASABLANCA
VARIOUS INDUSTRIES
OUED BOU REGREG
EL JADIDA
JORF LASFAR
PHOSPHATE INDUSTRY
OUED OUM RBIA
SAFI
MAROC- PHOSPHORE
(ACID PRODUCTION)
OUED TENNSIF
AGADIR
FISHERIES INDUSTRY
OUED SOUSS
0 km 50

Industrial Pollution

The sources of data are provided through document review, interviews, questionnaires and our own judgement.

The emissions are from conventional industrial sources, as well as from artisanal sources.

Industrial emissions into the air

The emissions from cars, buses and trucks represent a locally important source of air emissions. Approximately 1.185 millions vehicles are currently in circulation, consuming 384,381 metric tons of gasoline and 1.91 million tons of diesel fuel. The primary compounds emitted by vehicles include sulphur dioxide, nitrogen oxides, suspended particles, volatile organic compound, and lead. In addition, the emissions of nitrogen oxides and volatile organic compounds combine, in the presence of sunshine, to produce ozone, also known as « smog ».

In specific urban areas, especially Casablanca, Rabat, Marrakech and Tangiers, pollution from vehicles is likely to be very high because of the use of old, poorly maintained vehicles, poor traffic management, and extensive vehicle congestion during rush hour periods. This can result in serious local human health impacts.

Industrial fixed sources

Approximately 1 million petrol equivalent tons of fuel oil are consumed by industrial sources annually, producing approximately 2 million tons of carbon dioxide (CO_2), 180.000 tons of sulphur dioxide, 10.000 tons of dust and suspended particles, and 7.000 tons of nitrogen oxides. Emissions data are broken down by industry sector as follows

- Cement kilns represent one of the most important fixed sources of emissions into the air. The primary types of pollutant are dust, sulphur dioxide and nitrogen oxide emissions caused by the burning of fossil fuels to create heat as part of the production process, and the release of heavy metals.
- The two petroleum refineries in Morocco produce emissions of sulphur dioxide, nitrogen oxides, and volatile organic compound (VOCs).
- The phosphate processing facilities and Safi and El Jadida produce 204.000 tons of fluorine gas, and over 100.000 tons of CO_2 and 80.000 tons of CO_2.
- The electric generation facilities consume 1.5 million tons of fuel oil, 1.2 million tons of coal, and 32.000 tons of gasoil.

The total emissions of atmospheric pollutants in major industrial provinces are summarized in the table below:

Annual Emissions from Industrial Sources by Province (in tons)

Province	CO_2	SO_2	Particulates	NO_x	Hydro-carbons	CO	Fluorine
Agadir	42.600	1.800	3.070	658	42	80	0
Casablanca	451.000	6.600	2.420	1.700	100	160	912
El Jadida	31.000	84.000	30	70	4	5	95.000
Fès	19.000	80	55	290	9	37	0
Kénitra	111.000	2.300	100	260	17	18	0
Marrakech	16.300	810	1.200	330	22	41	0
Meknès	40.000	1.500	830	600	40	70	0
Mohammadia	43.000	3.600	50	100	13	8	0
Safi	156.000	81.000	600	600	34	60	110.000
Tangers	53.000	220	50	130	6	10	0

Area or Artisanal Sources

No data exist on the extent of emissions from artisanal sources, such as potteries and bakeries. However, suspended particles like sulphur dioxide and other pollutants are possible. The potteries use automobile tires soaked in gasoline to increase furnace temperatures, resulting in brief emissions of very hazardous pollutants.

Industrial Emissions into Water

The primary pollutants discharged into water resources in Morocco include 100.000 tons of chemical oxygen demand (COD) and 58.000 tons of biological oxygen demand (BOD), over 110 tons of heavy metals, including chrome and 3.300 tons of nitrates. The primary sources of these emissions are tanneries, olive processing, and phosphate refining.

- The tanning industry uses chrome to enrich the texture of products. It has been estimated that approximately 110 tons of chrome is discharged into the Sebou River each year from tanneries based in Fès and Meknès. Artisanal tanneries discharge a significant portion of this total. Large portions of these discharges are deposited in Local River sediment, while a small portion is carried downstream. The deposition of chrome into the river sediments may pose future environmental problems if floods or development activities disturb the sediment.
- The olive oil processing industry produces an organic waste byproduct known as margine, which is composed of water, oil and suspended particles. These industries emit some 1.4 million cubic meters of used water containing approximately 10.000 tons of margine.

- Phosphate processing discharges 6.5 million tons of suspended particles, 200 tons of phosphorus, 110 tons of heavy metals and 3.300 tons of nitrates into the Atlantic ocean. The phosphate processing facilities discharge over 1.051.410.000 cubic meters of water effluent, which represents 96 percent of industrial use of water.
- The textile industry is responsible for approximately 6.900 tons of suspended particles and 15.000 tons of BOD.
- The two refineries produce liquid waste during the oil - water separation process in the form of oil byproducts leaking into the surface water systems.

Health Impact

Chrome

The single most important of industrial emissions on health is in the area of heavy metal discharges into the Sebou river from the tanning industry. At present over 110 tons of chrome are deposited into the river at the centers of the tanning industry : Fès and Meknès. A smaller portion (1 to10 percent), remains in suspension depending on water flow characteristics. Humans are exposed to chrome deposits in the Sebou through bathing and drinking and other activities. Consumption of fish and invertebrates in the river can also lead to indirect exposure. However, ONEP reports that chrome does not exceed World Health Organization standards in drinking water.

Lead

Air pollution as a whole is not a major problem in most areas. However, the data indicates that residents living near areas of high traffic congestion in major urban areas are likely to be exposed to very high levels of lead and other pollutants.

Other gaseous air pollutants.

In high traffic congestion areas, humans are also exposed to high levels of NOx, ozone, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs).

Dust.

Exposure to dust from cement plants impacts human.

Organic discharges into rivers.

Large discharges of organic matter reduce oxygen levels, leading to a decline in plant and animal species in the river. This decline results in a lowering of the river system's ability to be self-cleaning. As a result, water-borne diseases such as diarrhea, typhoid, cholera, conjunctivitis, meningitis and hepatitis, become much more prevalent.

Economic Impact

The economic impacts of pollution include loss of economic resources such as:

fishing grounds, potential exclusion from export markets, declines in worker productivity from environmental diseases and illness, increased costs of medical treatment, increases in time and resources expended in obtaining non-polluted water, and increases in costs of maintenance of building and cultural and historic sites.

Loss of economic resources

The emissions of wastewater from the phosphate processing facilities at Safi and El Jadida have occurred at the same time as a rapid decline in sardine populations in the areas adjacent to the outflows, and a corresponding increase in sardine catches further south along the Atlantic coast. Overall trends in sardine catches nation-wide has not changed, though they are always characterized by wide fluctuations in yields from year to year. This has imposed transaction costs on fishermen and canneries, as Tan-Tan have replaced Safi as a major sardine port. Whether this will be a serious problem in the future depends on whether, in fact, the shift is due to the phosphate plants. In any case, industrial pollution is certainly a potential threat in the fishing industry.

Economic loss from restrictions in market access

A greater long-term economic risk to the emissions from the phosphate processing is the increased restrictions in market access, especially the European Community. At present, Morocco exports about 29 percent of total phosphate production to the European Community. The value of these exports is approximately $59.8 million

Exports of Phosphate by Country of Destination (metric tons)
(Data for 1 January - 30 September 1994)

Country of Destination	Exports (tons) Jan-Sept 94	% of Total Production
European Community	2.040.000	29.4
United States	1.373.522	19.8
Mexico	749.855	10.8
Poland	436.823	6.3
UEBL	391.310	5.6
Indonesia	346.742	5.0
India	297.584	4.3
South Korea	205.304	3.9
Croatia	178.620	2.6

The European Community imposes strict standards on production and product standards for all goods sold in the Community countries. As part of these standards, the environmental impacts of the products and processes are considered, and products that do not meet the environmental standards will ultimately be banned, even if produced outside the European Community. Thus, the high levels of pollution from the phosphate processing facility could result in the restriction, or ultimate prohibition, of exports to the European Community.

Productivity losses

The loss in worker productivity is likely to be especially acute in artisanal factories, such as tanneries, where workers are exposed to very high levels of toxic substances with little or no protective equipment or practices. Productivity losses would include an increase in absenteeism due to medical problems and reduced productivity while at work. These productivity losses are not likely to be realized in national accounts, because of the informal nature of this type of employment. Additional losses in productivity could also be pronounced for those workers living immediately downstream or downwind of major point sources.

Based on the health impacts of industrial and mobile source pollution, it is possible to make some general estimates of the possible productivity losses due to pollution. For childhood exposure to lead in automobile emissions, foregone earnings are estimated at about $400.000, a modest amount. This is expected to go up in the future as both the number of cars and urban population densities increase. For other sources of air pollution, it is not possible to distinguish by source. However based on the size of the population exposed to air pollution and the types of disease which can result, foregone earnings are estimated at about $2 million per year, also a fairly moderate sum in the context of other environmental pollution costs.

Increased costs of cleaning and maintenance

Sulphur dioxide, nitrogen oxides, ozone and other air pollutants accelerate the decay of the exposed surfaces of buildings and historic sites, increasing maintenance costs and possibly permanently damaging priceless cultural sites and artifacts. The increase in maintenance costs extends to houses, buildings, and other property where the costs include more frequent painting and repair and replacement of exterior walls and wall covering.

Impact on Natural Ecosystems

The two most important impacts of industrial pollution on biological diversity are the emissions of heavy metals and organic matter into rivers and the discharges of phosphate processing facilities into the Atlantic Ocean.

Discharges into rivers

Industrial discharges into rivers, especially the Sebou, have significantly reduced the level of biological diversity downstream. This is especially important in the case of fish and invertebrate species, and some plant species. The Sebou River is largely devoid of many species found in abundance downstream in Fès and Meknès. If not remedied these impacts may be carried out to the wetlands and coastal zones, although they are not currently affecting legally protected areas.

Phosphate processing discharges into the Atlantic

The development of two major phosphate-processing facilities at El Jadida and Safi has paralleled a rapid decline in sardine populations in certain areas of Morocco's coastline. The sardine population has shifted south. This shift might be due to pollution, over(fishing, or natural changes in the environment (such as changes in ocean currents or movement of phytoplankton). While sardine themselves are not an endangered species, there is some concern that they may be an «indicator species » whose decline may indicate serious problems for a wide variety of marine life not being monitored.

OBJECTIVES AND GOALS

The objective is through a study and pilot area to:

- develop a monitoring program using a scientific campaign within a period of time to be optimized;
- implement a data base of all the parameters involved in marine pollution,
- use satellite images for estimating and identifying some parameters that are needed for possible modeling;
- implement later a geographic information system for pre and post processing purposes (thematic map production);
- build an intelligent interface that can be used as a decision support system to assist and help decision and policy makers for taking remedial actions;
- build numerical models for pollution studies and impacts;
- integrate all the developments using information technologies and possibly Internet and Intranet.

For oceanography, the variables might be physical, chemical, biological or geological

For ocean and aquatic resources, quality, and pollution, the following will be examined:

- Mineral and energy resources
- Fisheries
- Ocean pollution
- Freshwater pollution

The overall objective being to archive and document all environmental data for the study area, while building a dynamic kernel for possible modeling and simulation using the existing data and knowledge bases.

This will:

- strengthen the building research capacity through continuing education programs and workshops, and joint research programs,
- enhance a dynamic training network in integrated environmental applications by organizing high level courses/workshops, study tours, scientific exchange through fellowships,
- later on, enhance regional cooperation through joint research exchange networks

Training engineers to perform environmental audits and working with industry groups to develop industry-led standards, and demonstrate cost-effective pollution prevention strategies, is required. SMEs have to be trained for an effective technology transfer and implementation of know how in the country. The education of engineering for international standards such as EEC's, EPA's, etc... will certainly contribute to best understanding, rapid action/reaction, writing manuals, setting up monitoring and control systems procedures, better environmental legislative and regulatory requirements, emergency procedures, learning an integrated approach to environmental management, etc...

PROJECT METHODOLOGY

A good way to study such problem is to use remote sensing completed by some investigations in situ. Appropriate computer processing satellite data will help in measuring the atmosphere transparency, water deposit, and soil erosion. Furthermore, the periodic satellite scanning of the area of interest will permit the evaluation of threatening to the area spatially as well as time wise. The Spot and TM-Landsat data, for the test sites, should be suitable for marine applications. These applications include mapping turbidity plumes, estimating suspended sediments, and mapping bathymtry, in detecting Sea grass beds, analyzing watercolor variations and detecting chlorophyll blooms in some estuaries. The good radiometric sensitivity will make the Spot and TM6Landsat more accurate in quantitative measurement, such suspended sediments concentrations, wet-bands productions, and wetlands and land use classification.

The heterogeneous data acquired will be integrated within an information system and coupled to numerical modules for assisting decision-makers as discussed below.

MILESTONES, DELIVERABLES AND EXPECTED RESULTS

OBJECTIVE 1- Derivation of parameters for modelling of pollution from satellite remote sensing methods

WORKPACKAGE 1- Elaboration of the data basis: existing data, and Implementation of a 2-year experiment to acquire additional hydrodynamic/pollution and remote sensing information.

The reference sites

Ground truth information will be obtained from the monitoring network to be designed and implemented in Safi area (study area)

Elaboration of the ground databases

A long-term experiment is planned for two years. Extended ground truth collection in support of data from satellites is an essential part of the study. Extensive field surveys will be done. During the intensive period of experiments, fields and remote sensing measurements will be done over specific tests sites of sub-units in the study area.

Elaboration of the remote sensing data basis

Optical Data Bases

The SPOT and LANDSAT-TM images for the test sites will be acquired up to minimum two (preferably three times a year for the 2-years period (1997-1999).

Radar Data Bases

The ERS-2 images will be acquired on a basis of at least 8 time a year for the 2-year period. At least two pairs of RADARSAT images are requested each year at two different incidence angles (high and low) at very close dates. SAR data products must be corrected for the local slope in the studied areas. Correction modules are available in the Italian institutes.

WORKPACKAGE 2- Derivation of oceanographic pollution surface indices from remote sensing

OBJECTIVE 2- Demonstration of the potentiality to pollution monitoring from indices derived from satellite remote sensing.

Integration of Satellite Remote Sensing Data in Pollution Models

Implementation of the available spatial parameters obtained with remote sensing techniques in pollution modelling.

The potential of remote sensing is to provide information on the spatial variability of some parameters characteristics of the area (as bathymetry, cover type, slope, roughness, etc).

Integration of two-year series of remote sensing data in pollution models

Following the aforementioned steps, the integration of remote sensing data in pollution models will be fully tested under real conditions. Data from two time series of ground and remotely sensed database collected over two years.

To achieve this aim, first, sensitivity tests on the numerical models will be performed to determine the importance of input parameters in space and time. The expected results of this analysis will be:

-To foresee the improvement of remote sensing data integration by situating the requested precision of input parameters and the quality and limitations of remotely sensed information derived from the developed algorithms,

-To define a procedure to integrate remote sensing data: priority of importance of remotely sensed indices, order and number of their use, temporal sequence of their integration in modelling of the study area.

OBJECTIVE 3- Integrated Coastal Zone Management: Coupling and Integrating within a Decision support System of GIS, Remote Sensing and Numerical Models for Marine pollution Risk assessment; Case Study Safi Zone.

The figure 1 shows the study and pilot area. We would like to develop all the approaches and methodologies to this study zone and extend later to the 3,500 km of the Moroccan coastal zone, and may be later on within EEC framework build a regional program for monitoring and follow up in the region.

WORKSHOP ON INDUSTRIAL POLLUTION ASSESSMENT AND PREVENTION IN MEDITERRANEAN COASTAL AREAS

18-20, November, 1998, Izmir, Turkey

by

N.TASPINAR

Department of Civil Engineering, Izmir-Turkey

Dealing with "Hot Spot" –Some practical examples: discussion led by Mr.E.Feoli and Mr.L.F.Cassar, ICS/UNIDO, Trieste.

Inputs by : Mr.A.Chouki, IMST, Izmir

: Mr.D.Ouazar, Ecole Mohammadia d'Ingeniers, Rabat; and

: Mr.N.Taşpınar, Department of Civil Engineering, Izmir.

1.Industrial and Domestic Discharges

The Mediterranean and Aegean Coastal Zone

There are various types of industries along the coasts of the Mediterranean and Aegean Seas.

The dominant types of industrial activity are textile manufacturing, food processing; chemical production, mainly fertilizer and paint production, metal products manufacturing and pulp and paper production.

From the point of view of the pollution load, the most important types are iron and steel works, textile manufacturing, fertilizer (especially phosphate fertilizer plants) and pulp and paper production, since the wastewater's or wastes originating from these types of industries contain priority pollutants such as Hg, Cg, and toxic organics.

Figures 1.1, 1.2 and 1.3 indicate the major point sources of Hg and PAH levels in coastal waters of the Mediterranean and Aegean Sea.

In construction these figures, marks were placed to indicate the sources without considering the magnitude of pollution, since there is no available information for each of the sources.

From the evaluation of the figures for Hg and PAH, it can be observed that relatively higher Hg and PAH levels appear close to the predetermined sources for these pollutants.

BOD Load from the coastal regions of Mediterranean and Aegean Sea were estimated on basis 54 g/cap/d BOD load (Figure 1.4).

Populations of the regions were taken from the documentation of the 1985 Census of Population.

However, in these estimates population increases of some touristic regions during summer month were not considered.

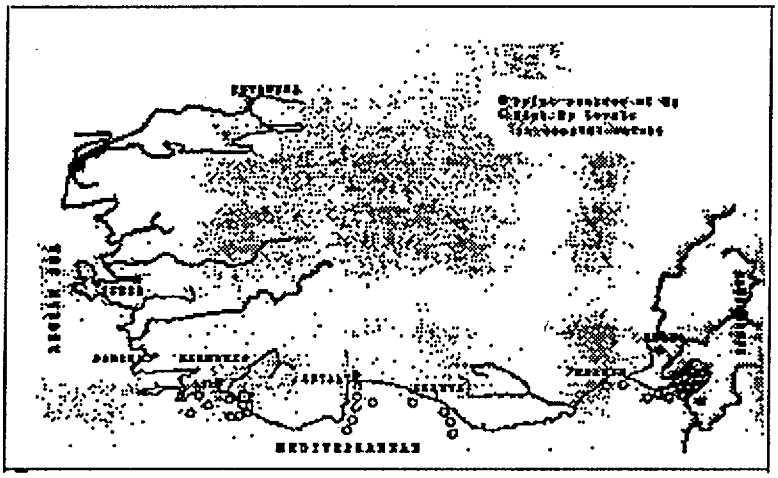


Figure.1.1.Industrial Mercury Sources and Coastal Sea Water Mercury Measurements points in the Mediterranean Sea.

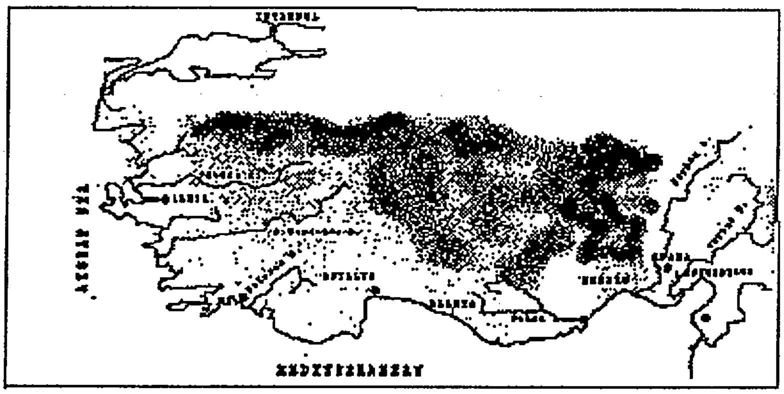


Figure.1.2. Industrial Cadmium Sources in Coastal Mediterranean and Aegean Seas.

Increase in BOD load of the touristic regions due to these population differences can be definitely be expected during summer months. Establishment with populations higher than 1000 are indicated in Figure 1.4, Figure 1.5 and Figure 1.6 indicates the Hg and Cd loads originating from domestic discharges.

2.Industrial Pollution in Izmir Bay

Izmir bay was too attractive swimming resort in 1960's but has turned to a stinking swamp due to the industrial as well as domestic effluents.

The main reason for this has been demographic explosion vis-à-vis inter provincial migration.

The history of province goes back to the year 3000 BC All through these years it has served an important trade center and even today is the third highly populated province in Turkey.

The coastal zones covers an area about 150 km, with many important touristic resorts like Urla, Seferihisar, Kuşadası, Karaburun, Foça, Çeşme and Selçuk.

In the middle of 15 Th. century population of province was about 200.000 but has increased to 2.5 million today.

In 1965 population density was 100 persons/km^2 but went up to 200 persons/km^2 in 1990 (Erdem et al). Today this portion is 1000 persons/km^2.

In the next 30 years population increase followed by heavy industrialization is expected to triple the waste water flow as well as the load of organic and inorganic pollutants in to bay.

In drastic steps are not taken the provincial coast will face many difficulties in near future.

Izmir is an important industrial area and some industrial sectors like Tanneries, leather products, wool and cotton textile, food mills, detergent manufacturing plants as well as other food manufacturing premises such as flour mills, canneries, cookeries, breweries etc. And slaughterhouse with allied processing units; Paint and dye industry area among these industries.

Industrial wastewater discharges have adverse effects on the Bay of Izmir, which possesses a highly complex hydrodynamic structure.

Industrial effluents obscure the chemical analysis to control the quality of seawater while some pollutants precipitating and inducing contamination of sea bottom.

Izmir bay can be split in tree parts

- Inner bay
- Middle bay
- Outer bay

Table.2.1. Heavy Metal Pollution Load of the Izmir Bay. (Source: By A. Müezzinoğlu & F.Şengül, 1986)

Izmir Bay	Water sample			Bottom sediment sample		
Pollutant Concentrations	Cd (ng/l)	Hg (ng/l) max	Cr (ng/l)	Cd mg/kg	Hg mg/kg	Cr mg/kg
Inner Bay	91	107 -981	5600	0.367	1.671	111.0
Middle Bay	65	94	5500	0.362	1.667	45.5
Outer Bay	64	62	4600	0.361	1.664	28.5

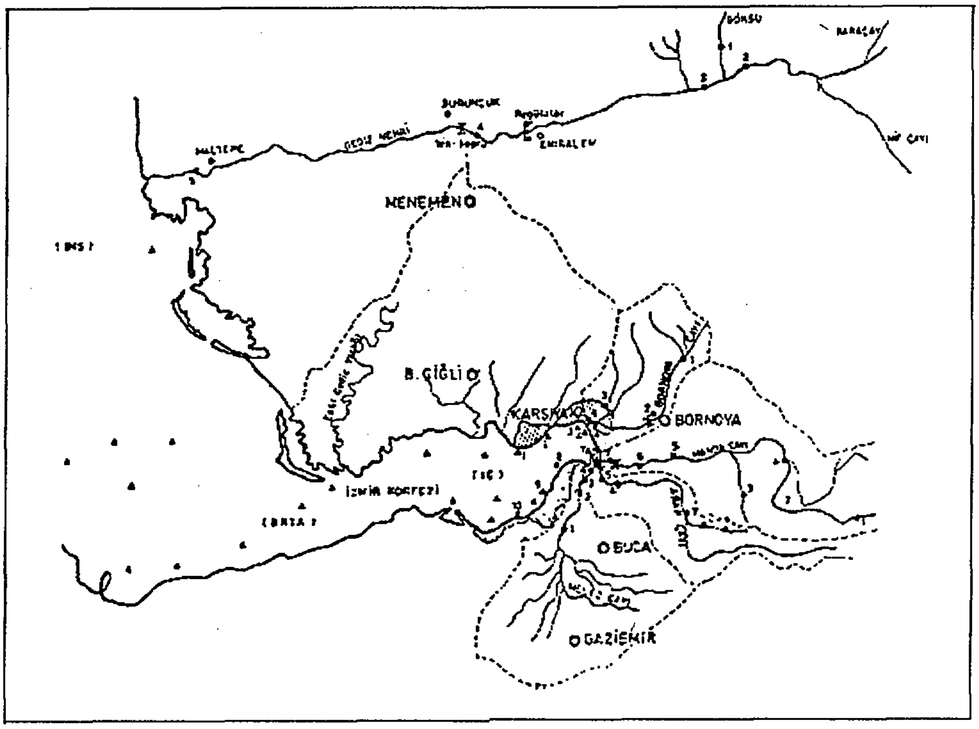


Figure.1.1.Important river basins pollutants to Izmir Bay

In table 1.2 can be seen that the heavy metal pollution loads of the Izmir Bay is very high.

In this scope, water and sediment samples taken from points of critical section and analyzed for total dissolved chromium, cadmium and mercury levels. As its known, mean Cd concentration level is 20 ng/l in Mediterranean, 40 ng/l in Aegean sea. Wonk and ark (1983) fined mean Cd concentration level 10 ng/l at the middle bay. Other side the best important metal pollution loads of the Izmir is chromium. This pollutants coming from Manda, Arap and Bornova Creeks and Gediz river. In order to indicated the pollutant loads it is necessary to know wastewater discharges and pollutant concentrations.

Using the associate pollutant parameters in 1985 year of the industrial and domestic wastewater discharges the biochemical oxygen contents, suspended solid materials, azot and phosphors pollutants loads have been calculated by Cinar and conclusions are given as below the table.

Table.2.2. Industries and Domestic Wastewater Discharges the city of Izmir in 1995.

Parameters	Source		
	Domestic	Industrial	Total
Flux (m^3/day)	245000	93000	338000
BOI (kg/day)	112000	102000	214000
Suspended solid maters	117000	49000	166000
N (kg/day)	6125	2325	8450
Phosphors(kg/day)	1960	140	2100

Table.2.3.Domestic and Industrial wastewater Flux and Pollutant Projections the city of Izmir in 2005.

Parameters	Source		
Flux (m^3/day)	420000	118000	538000
OBI (kg/day)	173000	130000	303000
SSMC (kg/day)	184000	62000	246000
N (kg/day)	10500	2950	13450
P (kg/day)	3360	180	3540

Table.2.4.Domestic and Industrial wastewater Flux and Pollutant Projections the city of Izmir in 2010.

Parameters	Source		
Flux(m^3/day)	628000	143000	771000
BOI (kg/day)	242000	157000	399000
SSM (kg/day)	255000	75000	330000
N (kg/day)	15750	3575	19275
P (kg/day)	5020	215	5440

Table.2.5.Domestic and Industrial wastewater Flux and Pollutant Projections the city of Izmir in 2015.

Parameters	Source		
Flux(m^3/day)	898000	168000	1066000
BOI (kg/day)	310000	185000	495000
SSM (kg/day)	327000	88000	4150000
N (kg/day)	225000	4200	26700
P (kg/day)	7184	252	7440

From the conculation of these tables they can be sad that there is two main cause of marine pollution's .

- creeks
- outfull piping

3.Extend of Industrialization

All the coastal zones in Turkey are important areas from the industrial and commercial point of wives. Adana and Izmir are leading provinces where almost all types of manufacturing industrial activities are located (Tables 2.1, 2, 3) Among the industries located in Adana, cotton processing and related textile production is most important class.

The Mediterranean coast line from Taşucu to Iskendurun is a significant industrialised area of the country having many types of industrial establishments such as textile, food, paint, soda, paper and paper products. Ferro-crome, plastic materials, artificial fertiliser and mining activities.

In a view of pollution resulting from industrial effluents, industries established in the Izmir area are extremely important. Among the industries located in Izmir, tanneries are the most important class from both of the point of view of heavy metal pollution and from the point of view of economics.

The second and third most important class are the textile and paint manufacturing industries. Another major source of pollution located in Izmir is the petroleum refinery located in Aliaga Bay.

4.Management

As it's known, Environmental Management undeniable necessity for Developing Countries.

There are also some two important dangers which developing countries are facing;

- The destruction of the environment due to the improper use of the natural recourses during the struggle for the economical development.
- The attempts made by advanced countries to "dump" or "export" their wastes- especially the hazardous one or the industries producing such wastes to developing countries.

The coastal area represents the interface between land and the sea and includes primarily the shoreline environments and the adjacent coastal waters of the exclusive economic zone (EEZ).

Today 60% of the world's populations is living in coastal regions and by 2050 realistic estimate predict that 10 billion people will be living along the coast.

About 95% of the total population growth is expected in developing countries and by the of this century more than two thirds of the population in the developing countries is located coastal areas.

As its known, the management of the coastal, natural recourses and the design of coastal engineering works demand an accurate knowledge of the wave, current and the other oceanographic parameters.

Examples of such activities are; shipping, offshore platforms, breakwaters, fisheries, oil and gas production and waste water disposal systems.

In the past, information should have been suggested only by conventional monitoring studies (in-situ measurements). But now, the new techniques are available.

For example, the use of computerised geographical information systems (GIS) make it possible to process large volumes of geographically referenced data from multiple sources that can be integrated to produce maps, monitor changes in recourses, co-ordinate recourse uses and simulate impacts from management decisions; remote sensing systems using satellites and aircraft's make it system it possible to collect and analyse information about recourses and land use over large areas, Marine buoy systems make it possible to continuously monitor and evaluate trends in environmental parameters and pollution levels in the sea, on-line via satellite and developments in knowledge based computer systems (such as expert systems), simulating modelling techniques and analytical methods has provided managers as well as scientist with powerful decision support systems at different levels.

The nature of the issues dealt with in a coastal management programme clearly indicates that the management problem has a regional and international dimensions.

5.Regional Planning

Regional development planning is a complex procedure that requires input from numerous sources and usually involves a large group of people with different backgrounds and objectives. Physical planning, socio-economic, technological and environmental considerations have to be integrated in the design and development project.

In the polluting industries, the cleanup of toxic waste disposal sites and waste management of major cities and industries while the political and socio-economic and institutional aspects may often be of dominant importance, there still is considerable demand for timely and relevant technical and scientific information processing point of wives, these problems areas share the same characteristics.

Planers and decision makers and increasingly the general public, need and demand information to put the problem into context, from monitoring data to applicable standards.

This information needs to be provided in a format that is directly understandable and useful. Time is always important; we need the information immediately.

In this concept, sea water climate, wind and weather analysis, temperature, sea water conditions, physical parameters and currents as observed in the offshore areas for the pollution monitoring purposes.

Conclusions

Turkey's coast covers the Black, Marmara and Aegean Seas. Although industrialization and urbanization are quite recent phoneme, they are generating problems on the coasts of Turkey.

In the eastern Blacksea region the evaluation of a settlement pattern parallel to the coasts and in the Marmara region extension of industrial zones have created critical marine pollution.

In the Mediterranean, urban-industrial centers are not long the coasts but concentrated in certain locations and this situation creates the chance to preserve vast amounts of coastline.

The prospect of pollution, originating from external causes is endangering such preserved coasts.

Turkey's main problem arises from the fact that it has to industrialize and still preserve its natural and cultural assets.

In this respect, considerable steps have been achieved in the fields of planning and legislation.

Round-Table discussion on networking:

Mr. E. Feoli, Mr. G. Guerrieri, and Mr. I. Trumbic.

Evaluation and Closure of Workshop.

The participants were briefly informed about the structure of the activities implemented within the framework of the Mediterranean Action Plan (MAP) and the Priority Actions Programme (PAP). Particular stress was put on the importance and role of the Mediterranean Commission for Sustainable Development (MCSD) as new organisation for the management in the Mediterranean with the aim to carry out sustainable development of the region. Such an approach is considered innovative, because it is the first regional example of that kind in the world. The importance of this approach is in the fact that the representatives of the Mediterranean countries are gathered around the same table with the representatives of NGOs, other IGOs, professional institutions and associations, local authorities, etc. However, MAP still remains the basic tool in the implementation of the provisions of the Barcelona Convention, offering a unique professional and organisationl support to MCSD. The Integrated Coastal Zone Management (ICZM) is one of the priority themes of MCSD in the framework of which PAP is playing a referential role.

The further presentation was focused on the future development of ICZM in the Mediterranean and the topics which would dominate in the following years. These experiences have partially resulted from a recently completed METAP/PAP study on the assesment of ICAM initiatives in the Mediterranean. Lessons learned during the last ten years of ICAM implementation in the Mediterranean, as well as the recommendations for the further development of the activites were presented to the participants

The development of ICAM activities has been directed towards three main targets,namely: gaining scientific knowledge on particular natural and socio-economic coastal zone systems; a set of technical solutions, and planning and management tools and techniques; and management policies and a set of instruments for their implementation. This division is still actual, and each of its components should be developed either separately, or within the framework of the integrated approach directed towards, sustianable developent of coastal zones in the Mediterranean.

The enlargement of scientific knowledge on natural and socio-economic coastal zone systems will remain one of the priorities of ICAM. Although, on one side, there is the need to gather as fast as possible the necessary information to come to management decisions, it is, however, impossible to come to a better long-term understanding of coastal systems without scienitific research. The development of techniques to optimise the objectives of short and long-term needs will remain a priority also in the future. Or, in other words, the need remains for large and long-term research project, as well as for short-term technigues enabling a fast gathering of information. However, the integration of the various coastal information systems, even at the meta level is of the utmost importance. Also, the PAP initiative is being developed in that direction, and an attempt will be made in Izmir to carry it out in the framework of the National Training Workshop on Integrated Coastal Zone Systems as an instrument to provide support in the decision making on ICAM.

In the framework of the other group, there is, nowadays, a certain consensus in the planning of coastal zones to create samller homogeneous zones, which would, then, be surveyed using simple methods, and in that way the planning process would be carried out much faster. Furthermore, there is the need to elaborate the criteria for defining the use of coastal zones, or coastal zoning, being still one of the most efficient tools in the implementation of coastal zone plans, and the protection of coastal zones, either as areas of particular values (ESAS or Environmentally Sensitive Area listed in the IUCN nomenclature on specially protected areas), as well as theareas outside of these zones, which are not always distinguished by their natural, characteristic. Tha objectives of the development of coastal zones are being directed to should always be the starting point, and the techniques for optimising the objectives, conflict resolutions,etc. would remain one the priorities in the integrating tools in the planning process. The third direction which solud be further developed in the immediate future is environmental assessment with particular stress put on he technique o the Strategic Environmental Assessment (SEA) for the needs of ICAM. This concerns a technique, which has not yet been clearly defined, as it is the case with EIA, and which is sometimes difficult to define as a practical technique, but the need for which is so evident. From my point of view, in the further development of this technique the basic fact is that cumulative environmental effects of developmental decisions in coastal zones should be determined in many instances. Finally, very important are the techniques for economic valuation of coastal resources and the relevant economic instrument. Besides the set of "classic" instrument, being in use for a long time, it is only the efficient techniques for the evaluation of coastal zone resources which will result in a practical set of economic instruments. The other possible issues to be elaborated and developed in ICAM are those dealing with coastal legislation and the means for their successful implementatino, the coastal GIS, carrying capacity of natural systems, assimilative carrying for residuals, etc.