Management of Marine Environment

ENVS 590

Instructor
Dr. Assad A. Al-Thukair

Framework of Marine Pollution Management

Roles	Level	Organizations
Prevention Control	**Facility Level**	Pollutants generators
Policy/Laws Partnerships Funding	**National Level**	Local Authorities (e.g. Env. Agency, Coast guards, ..etc)
	Regional Level	Gulf Region ROPME, MEMAC
Agreements Funding Capacity Building	**International Level**	UNEP IMO Others

Success: Cooperation at all levels
(through Legal and administrative arrangements)

Management of
Land-based Pollution

Worldwide Facts and Figures

According to **UNEP:**

- Over 75% of marine pollutants originates from land-based activities (including municipal, industrial and agricultural wastes and run-off).
- Over 50% of the world coasts are threatened by development-related activities.
- Over 80% of wastewater is discharged untreated to inland and coastal waters.

UN global program for the protection from land-based activities.

Table 9.2 UN Global Program of Action for the Protection of the Marine Environment from Land-Based Activities (http://www.gpa.unep.org/about/tag10/)

Issue	Principal UN agency
Sewage	World Health Organization http://www.who.int/en/
Oil and litter	International Maritime Organization http://www.imo.org/home.asp
Nutrient and sediment mobilization	Food and Agriculture Organization http://www.fao.org/
Heavy metals	UN Environmental Program http://www.grid.unep.ch/
Persistent organic pollutants	UN Environmental Program
Radioactive substances	IAEA International Atomic Energy Agency http://www.iaea.or.at/
Physical alterations to the coast	UN Environmental Program

Management of Land-based Pollutant at National Level

- **Identification and assessment of problem** (e.g. marine problems, contaminants types and sources, ..etc)
- **Establishment of priorities** (e.g. relative importance, appropriate options, ..etc)
- **Setting management objectives** for priority problems
- Identification, evaluation and selection of **strategies and measures**
- **Criteria for evaluating effectiveness**
- **Program support elements**

Management of Marine Pollution at Facility Level

Useful information for effective marine pollution management approach:

- Where does it come from? Can I manage it at source?
- What form does it take?
- What is the level of contamination?
- What happened to it in the sea?
- What does it do to the plants and animals there? If plants and animals are affected, does it matter?
- To whom does it matter? What other interest is affected? How much does it matter to them?
- If it does matter, what can we do about it?
- What do we do with the polluting material if it is not put in the sea?
- Would the alternative be than putting it in the sea? How much would it cost?

Management Scheme

- Pollution Prevention

(elimination or reduction of pollution from source)

- Pollution Control

(mitigation of pollution through engineering or procedural measures)

- Pollution Monitoring

(repeated scope-specific measurements overtime)

Useful tips in Marine pollution Management

- It is necessary to identify major marine pollutants and establish effective strategy to manage them in environmentally friendly way.

- Care should be taken to ensure that in solving pollution problem we are not creating a worse one in a different environment (ex. from sea to land or vice versa).

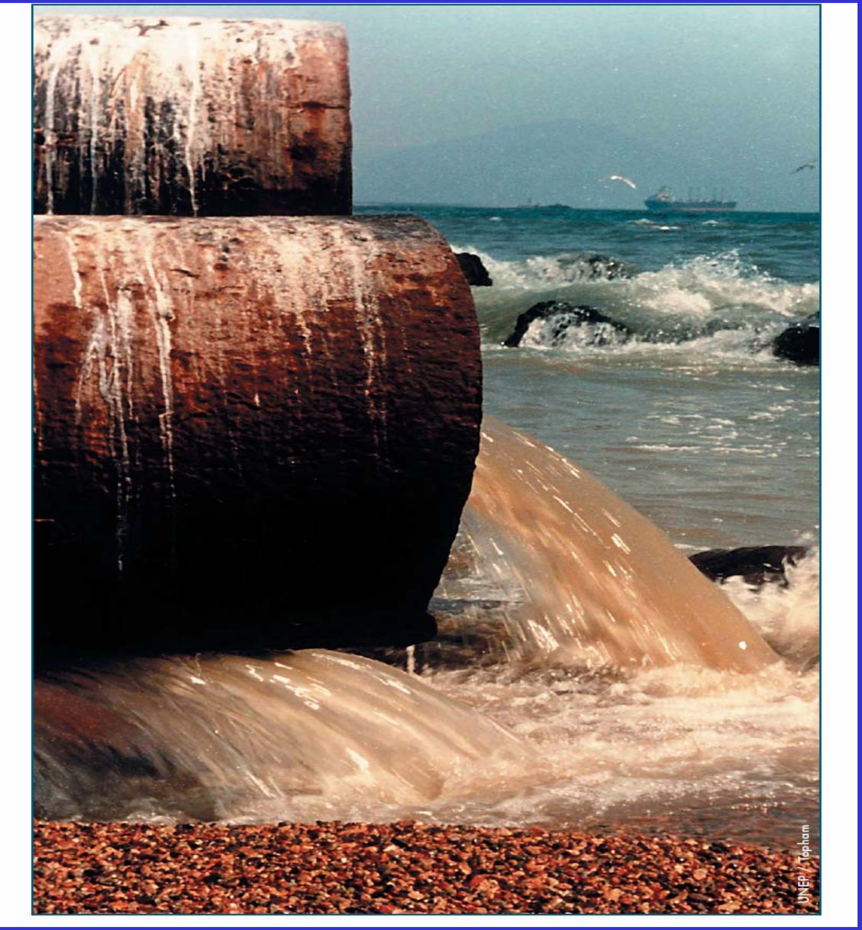
- Fostering technologies and processes that produce little or no waste and withdrawing damaging substances to marine from use.

  - DDT, and PCB’s were banned but still present in the marine environment.

  - It is impracticable to withdraw some environmentally damaging substances from use (ex. Oil & seabirds loss).

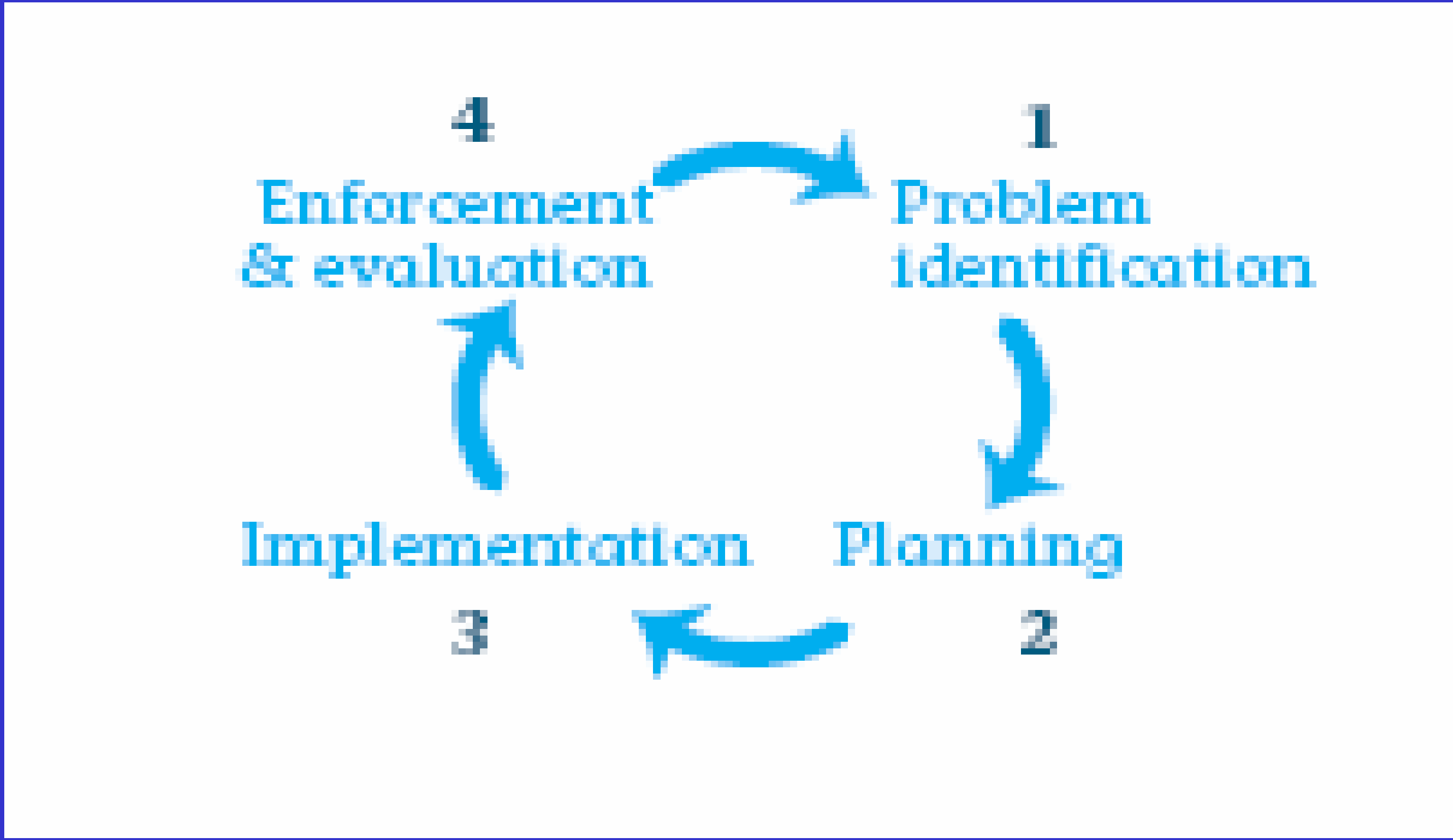
- Remedial actions are sometimes instituted before it is known whether pollutants have a damaging effect on marine environment. (e.g. Booming of desalination water intake).
- An industry or government body may be obliged to undertake useless activities so that they can be seen to be active. (e.g. Late dispersant spraying on marine oil spill)
- Activities may be harmless, but they are expensive and wasteful of resources that might be better spent for some other purpose. (e.g. Irrational monitoring).
- Effective collaboration between concerned marine stakeholders. (Who are the stakeholders ?)
- Full knowledge of relevant marine laws and regulations

Examples on Management of Land- based pollution



Example 1:

Municipal Wastewater Management



Source: Guidelines on Municipal wastewater management, UNEP, 2004

Facts and figures on costs of wastewater management

- To collect and treat a cubic meter of wastewater is usually more expensive than the intake, treatment, and distribution a cubic meter of drinking water;
- Operating and maintenance costs of sewerage networks and treatment facilities are higher than the annual depreciation of capital invested in the infrastructure.
- Biological wastewater treatment (the most widely applied technology) consumes substantial amounts of energy, generates large quantities of excess sludge, and, thus, requires relatively expensive equipment, operation and maintenance.
- In most EU countries, governments spend more money on wastewater treatment than on flood protection, pumping, and dredging combined.
- Many low and middle-income countries in Central and Eastern Europe cannot afford the technologies needed to comply with EU standards: the estimated time needed to finance such technology far exceeds the economic lifetime of the facility (20-30 years) and often even that of sewers (50-60 years) *(Gijzen 1997)*.

Logical framework for wastewater management

1 **Problem identification**
- monitoring
- assessment and identification of the need for action.

2 **Planning**
- review of information
- identification of needs and opportunities
- formulation of management plan
- setting objectives and standards
- formal adoption.

3 **Implementation**
- design management tools
- operational management: on-site versus off-site
- institutional arrangements, incl. capacity building, awareness raising and public participation

4 **Enforcement and evaluation**
- operational management of water quality
- evaluation

Logical framework for municipal wastewater management

Phase 1: Problem identification

☐ **Tasks: Monitor and assess the current situation:**

- focus on areas where most positive impacts can be expected from new wastewater management;
- involve local communities and other local stakeholders in the assessment, so raising public awareness and stimulating participation;
- identify all stakeholders and key agencies;
- assess wastewater (both quantity and the quality) from industries and small enterprises that is mixed with domestic wastewater;
- assess of urban runoff (both quantity and quality) and the frequency with which urban runoff drains into the wastewater collection system;
- identify those contaminants that cause most serious harm to human health and the environment;
- assess the needs of all stakeholders.

☐ Are staff, funds, facilities, mechanisms in place to implement the tasks?

Phase 2: Planning

☐ **Task: Review existing information:**

- national economic and development plans;
- related sector policies (water supply, solid waste management, land use planning and zoning, urban development);
- demographic and socio-economic projections (rate of urbanization; projections on income -per capita and distribution-, water supply and water demand);
- the existing legal framework including standards and regulations;
- the current institutional framework;
- the current financial framework.

☐ Is access assured to required data and documentation?

☐ **Task: Identify potential obstacles and opportunities:**

- obstacles like insufficient institutional capacity or financial resources;
- opportunities such as collaborating with breweries, food processing and tourism industries which all require clean water;

☐ **Task: Formulate objectives, standards and management plan:**

- make an analysis of technical, economic, and social feasibility of different options;
- consult and negotiate with all stakeholders;
- include clear objectives that are measurable and verifiable;
- allow local flexibility in implementation of regulation;
- follow a realistic step-wise investment approach;
- apply spatial differentiation, considering specific physical and socio-economic characteristics in neighborhoods.

☐ **Task: Formal adoption:**

- establish an interagency coordination mechanism between relevant authorities (sectoral synergy) and all levels (from national to local);
- approve staffing and required organizational changes;
- adopt policies, goals, standards, and management tools;

- assign, by legislation, responsibilities among the actors (monitoring, revenue collection, operation, and maintenance);
- approve the funding allocation.

Are staff, funds, facilities, mechanisms in place to implement the tasks?

Phase 3: Implementation

☐ **Task: Design management tools**

- provide management tools in the form of regulatory and economic or market-based instruments
- support instruments by legislation and other types of authorization.

☐ **Task: Organize operational management: on-site versus off-site**

- make a distinction between cheaper on-site sanitation and more complex, expensive off-site collection and treatment.

☐ **Task: Set up institutional arrangements**

- ensure institutional arrangements for management tasks and tools, as well as for capacity building, raising awareness, and public participation.

Are staff, funds, facilities, mechanisms in place to implement the tasks?

Phase 4: Enforcement and evaluation

☐ **Task: Operational management of water quality:**

- ensure rules that are accepted by society and that can be enforced;
- ensure strong and objective enforcement when breaking the rules can give economic benefits

☐ **Task: Evaluation:**

- provide for regular monitoring and evaluation, so that timely improvements can be introduced when necessary.

☐ Are staff, funds, facilities, mechanisms in place to implement the tasks?

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Keys for Action on Municipal Wastewater: focussing on technology selection

1	Secure political commitment and domestic financial resources.
3	Do not restrict water supply and sanitation to taps and toilets.
4	Develop integrated urban water supply and sanitation management systems also addressing environmental impacts.
5	Adopt a long-term perspective, taking action step-by-step, starting now.
7	Select appropriate technology for efficient and cost-effective use of water resources and consider ecological sanitation alternatives
8	Apply demand-driven approaches.
9	Involve all stakeholders from the beginning and ensure transparency in management and decision-making processes
10	Ensure financial stability and sustainability.
10.1	Link the municipal wastewater sector to other economic sectors.
10.2	Introduce innovative financial mechanisms
10.3	Consider social equity and solidarity to reach cost-recovery.

Multi-criteria analysis for technological selection

A technology should be:

- environmentally sound;
- appropriate to local conditions;
- applicable and efficient in the context of the entire river basin;
- affordable to those who must pay for the services.

Other aspects to consider during the technology selection process are:

- awareness and the need for changes in behavior;
- workable policies and regulations;
- possibilities for enforcement;
- technical performance and reliability (under variable wastewater flows, compositions and operational problems);
- institutional manageability (planning, design, construction, operation and maintenance capacity, including local availability of skilled human resources);
- investment, operation, and maintenance costs.

Sanitation technology approaches

Five different technology options can be distinguished ranging from prevention up-front and simple low-input systems to sophisticated high-input systems:

1 start with pollution prevention and wastewater reduction at the source;

2 apply on-site treatment and re-use to treat surplus wastewater;

3 install off-site transportation and collection systems for wastewater and stormwater (combined or via separate sewer and drain systems);

4 apply simple off-site treatment such as:

 a) natural treatment of collected wastewater using the natural self-purification capacity of receiving soil or water bodies;

 b) re-use and valorization using simple technology and ecological engineering so conversing wastewater into a valuable resource;

5 install conventional off-site wastewater collection and centralized, high technology, end-of-pipe treatment.

From Varis and Somlyody (1997)

Benefits of pollution prevention in wastewater management

By reducing domestic water consumption, generating less polluted wastewater at the source, and using separate collection systems for different quality water:

- wastewater becomes better treatable;
- smaller, lower cost water supply and wastewater systems are required;
- development of dry sanitation systems is stimulated (see Box 3.8);
- waste components can be recovered and re-used; and
- wastewater of different quality can be re-used effectively for different purposes.

Example 2:
Thermal Pollution

Sources:

- Power plants
- Desalination plants
- Nuclear plants
- Water cooling systems

AL-JUBAIL PLANTS

The World's Largest Desalting Plant

Al-Jubail Desalination/Power Plant as it appeared on the cover of the first issue of the D&WR Quarterly in 1991

Types of Pollution

Thermal Pollution

Heated effluents discharged from power stations and nuclear-powered units, causing adverse environmental impacts on marine environment.

Brine Pollution

High salinity effluents discharged mainly from desalination plants, causing adverse environmental impacts on marine environment

Atmospheric Deposition

Gasses and particulates deposited from air on to water and land

Desalination & Power Plants in KSA

The SWCC provides **70%** of potable water needs to the public.

There are **31** Desalination & Power Plants in the kingdom.

KSA has **31 Discharges**, **4** on Eastern Coast and **27** on Western Coast

Useful information

About **20 million m^3** of cooling water, **12 C** above the ambient sea temperature, are discharged for 1000 MW of electricity generated by oil or coal-fired power stations.

The total desalination capacity in the kingdom is a little over 6 million m3 /day of this 3.4 million m3 is produced by the Saline Water Conversion Corporation (SWCC). The SWCC provides 70% of potable water needs to the public.

Discharge water salinity is typically more than 10% of the intake water salinity.

Pollution Effects

Elevated temperature and Salinity	**Disturb enzyme activity, water balance and cellular chemistry**
Residual chemicals	**Forms by-products compounds which create environmental & health problems**
trace metals concentration	**Disease and mortality of marine organisms**
Effect of brine on plankton	**Reduce the density of phytoplankton and zooplankton.**

Thermal Effect

Many functions of aquatic animals are temperature controlled, for example,

migration, spawning, feeding efficiency, swimming speed, and basic metabolic rates (double with every 18 F increase in temperature).

Temperature influences feeding, respiration, osmoregulation, reproduction and growth in organisms.

Temperature stress causes ecotoxicological effects such as disturbed enzyme activity, water balance and cellular chemistry.

Effects on Benthos by reduce the numbers of species the community and stimulate excessive populations of individual species to nuisance conditions.

Beneficial re-uses of Discharges Heat

Aquaculture

Open-field Agriculture

Greenhouse Agriculture

Animal Shelters

Industrial Process Heat

Mitigation Measures and Monitoring

- Discharged directly into the ocean
- Mixing the discharges with power plant cooling water
- Land-Based remote sensing stations
- In-situ monitoring stations

Management and Control

-Location

-Use very long outfall channel

-Design the brine disposal system

-The hot reject brine should pass through separate cooling pond or tower.

-The power technology and proficiency of operations must be well maintained.

Desalination Plant Intake and Outfall Zones

Land-Based remote sensing station