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MED POL

UNITED NATIONS ENVIRONMENT PROGRAMME

COSTS AND BENEFITS OF MEASURES FOR THE REDUCTION OF DEGRADATION OF THE ENVIRONMENT FROM LAND-BASED SOURCES OF POLLUTION IN COASTAL AREAS

A. CASE STUDY OF THE BAY OF IZMIR

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with the help of G. Tuncel, U. Yetis and N. Talu

B. CASE STUDY OF THE ISLAND OF RHODES

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This series contains selected reports resulting from the various activities performed within the framework of the components of the Mediterranean Action Plan: Pollution Monitoring and Research Programme (MED POL), Blue Plan, Priority Actions Programme, Specially Protected Areas and Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea.

PREFACE

The costing of programmes designed for the protection of the environment, and the assessment of benefits from such programmes, is a crucial step in the environmentally sound management and sustainable development of the coastal and marine environment.

The present attempts [1], [2] to assess, on a global and on regional levels, the costs and benefits from the reduction of the degradation of the marine environment from land-based sources of pollution and activities in coastal areas revealed that the methodology used by government agencies and international financial and aid institutions for the cost-benefit analysis of environment protection measures vary considerably, and that at present there is no agreement on procedures which may lead to comparable results on a global or regional level.

As a contribution to the improved assessment of the costs and benefits associated with the environment protection measures, the preparation of two case studies was undertaken by UNEP, along the general methodological guidelines recommended by a recent meeting of government experts [3].

Taking into account the ongoing integrated coastal zone management pilot projects carried out in the framework of the UNEP-sponsored Mediterranean Action Plan, the Bay of Izmir (Turkey) and the Island of Rhodes (Greece) were selected as sites of the case studies. They represent two different, yet typical and complementary situations, common throughout the Mediterranean: one a large coastal urban and industrial centre, the other an island with tourism as the main economic activity.

The two case studies were successfully completed in short period and at low cost, thanks to:

- availability of information needed for their preparation;
- involvement of experts already familiar with the conditions relevant to the scope of the studies; and
- co-operation of local authorities.

The main conclusions of both case studies is that the benefits from environment protection measures would, if applied, significantly outweigh the costs of their application in long-term.

This publication contains the above mentioned two case studies.

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1 Sessions of the Preparatory Committee of the United Nations Conference on Environment and Development (Nairobi, 6-31 August 1990; Geneva, 18 March-5 April 1991; Geneva, 12 August-4 September 1991; New York, 2 March-2 April 1992).

2 Strategy for the Reduction of the Degradation of the Marine Environment from Land-Based Sources of Pollution and Activities in Coastal Areas (including an annex on Preliminary Estimate of the Costs associated with the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities in Coastal Areas) (UNEP(OCA)/WG.14/3).

3 Meeting of Government Designated Experts to Formulate a Draft Strategy for the Reduction of the Degradation of the Marine Environment from Land-Based Sources of Pollution and Activities in Coastal Areas (Nairobi, 9-13 December 1991).

BACKGROUND

The sixteenth session of the Governing council of the United Nations Environment Programme (1991), in decision 16/26 A on "Marine Pollution from land-based sources" (Appendix I), requested the Executive Director *to continue the preparation of elements for draft strategy options and actions to reduce the degradation of the marine environment from land-based activities*. The decision also calls on the Executive Director *to convene a meeting of government-designated experts to formulate a draft strategy, including a targeted and costed programme of action for reduction of the degradation of the marine environment from land-based sources of pollution and activities in coastal areas, and to complete a targeted and costed action programme for the Mediterranean as an input to the strategy, and as an example for the preparation of an international study*.

A document (UNEP(OCA)/WG.12/3) outlining the possible strategies and options for programme of action was prepared by the secretariat (Oceans and Coastal Areas Programme Activity Centre - OCA/PAC) for the meeting of government-designated experts, Nairobi, 9-13 December 1991. The document includes a preliminary estimate of the costs associated with the protection of the Mediterranean Sea against pollution from land-based sources and activities in coastal areas.

The draft of the document was reviewed by an Informal Consultation of Technical and Legal Experts (Nairobi, 30 September-3 October 1991), who recommended the preparation of specific detailed case studies on the costs and benefits from the reduction of the degradation of the marine environment, as a supplement to the preliminary estimate of the costs associated with the protection of the Mediterranean Sea.

In consultation between OCA/PAC, the Co-ordinating Unit for the Mediterranean Action Plan (MEDU) and the relevant national authorities, and taking into account the ongoing integrated coastal zone management pilot projects carried out in the framework of the Mediterranean Action Plan, the Bay of Izmir and the Island of Rhodes were selected by the secretariat as the sites of the case studies.

An ad hoc Consultation on Land-Based Sources of Pollution was organized by MEDU (Athens, 5 - 6 November 1991) to launch the preparation of the case studies. The Consultation agreed (UNEP(OCA)MED WG.32/2) on the terms of reference for the preparation of the case studies, including the outline of the studies and the timetable for their preparation.

The preliminary versions of the case studies were presented, as documents UNEP(OCA)WG.14/Inf.8 and WG.14/Inf.9, to a Working Group of the Meeting of Government Designated Experts to Formulate a Draft Strategy for the Reduction of the Degradation of the Marine Environment from Land-Based Sources of Pollution and Activities in Coastal Areas (Nairobi, 9-13 December 1991). The Working Group considered the preliminary studies in the context of costing action programmes for reduction of the degradation of the environment and recommended a general methodology for costing regional programmes and local studies.

Taking into account the comments and suggestions received from the Meeting of Experts, the two preliminary case studies have been completed and were presented, as documents UNEP(OCA)MED WG.45/2 and WG.45/3, together with methodologies used for their preparation (documents UNEP(OCA)MED WG.45/4 and WG.45/5) to the Consultation on Costs and Benefits of Reduction of the Degradation of the Marine Environment from Land-Based Sources of Pollution, organized by MEDU (Athens, 6-8 April 1992). The Consultation reviewed and revised, as appropriate, these documents and the two case studies constitute the two substantive sections of the present publication.

COSTS AND BENEFITS OF MEASURES FOR THE REDUCTION OF DEGRADATION OF THE ENVIRONMENT FROM LAND-BASED SOURCES OF POLLUTION IN COASTAL AREAS

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EXECUTIVE SUMMARY

The purpose of this study is to (a) demonstrate the application of cost-benefit analysis to the region of Izmir Bay; and (b) compare the cost and benefits that are likely to occur over the next 35 years from the restoration of the Bay.

Izmir Bay and Surroundings

Izmir Bay is one of the great natural bay areas of the Mediterranean and compares well with similar coastal areas in the world (Figure 1). The natural beauty and the economic advantages it offers has been recognised early in human history and have been exploited ever since. It consists of three bays: the Inner, the Middle and the Outer bays with the total surface area of over 500 square kilometres and a water capacity of 11.5 billion cubic metres. It has a total length of 64 kilometres and opens in the Aegean Sea. The hinterland is relatively fertile agricultural area watered by several rivers the largest of which is the Gediz which flows into the Outer bay. The climate of the Bay is relatively mild with a yearly annual temperature of 17 EC.

The Economics of the Bay

The main urban conurbation around the Bay is the Izmir Metropolitan Municipality, covering 88,000 hectares and a population of close to 1.5 million inhabitants in 1990. Izmir is an important industrial, commercial and cultural focal point. Industrial activities cover a large range of industries including food processing, tanneries, paint, chemicals, textile and petroleum refining. About 6,000 industrial establishments are registered with the Chamber of Industry in Izmir but many establishments are not registered.

The Aegean region around Izmir produces 15% of Turkey's agricultural output with 30% of the land in the region used for agriculture. The harbour's storage capacity is 200,000 tons with 25% of Turkey's export and 55% of its import passing through the port. Tourism is also an important activity with between 100,000 and 300,000 tourist annually either visiting or passing through Izmir. The saltpan of over 800 hectares produces over 1 million tons of salt annually. In addition defence activities are also present in the Bay.

Environment of the Bay

Urbanisation, industrial activities and agriculture impact heavily on the environment in particular on the water quality of the Bay and the shore areas. Domestic and industrial wastes, urban and agricultural runoff, discharges from ships, sediments and contaminated waters of rivers and streams have cumulatively had a significant adverse effect on the water quality and natural values of the Inner Bay. The Bay is heavily polluted with organic material, hydrocarbons, heavy metals, nutrients and pathogenic organisms; eutrophication of the Inner Bay is a serious problem throughout the year and red tide events are becoming more frequent.

Future Developments

Considerable planning effort has been made to prepare for the future development of Izmir and the surrounding coastal areas. Population projections indicate 4.1 million inhabitants by 2020 and nearly 5 million by 2025. This population scenario will to a large extent determine the environmental requirements for the future. Two basic scenarios could be envisaged. An industrial scenario where most of the jobs needed for the future labour force will be generated by industry or a touristic scenario where most of the jobs will be generated by tourism and related activities. Many other variations between these two basic propositions could be assumed.

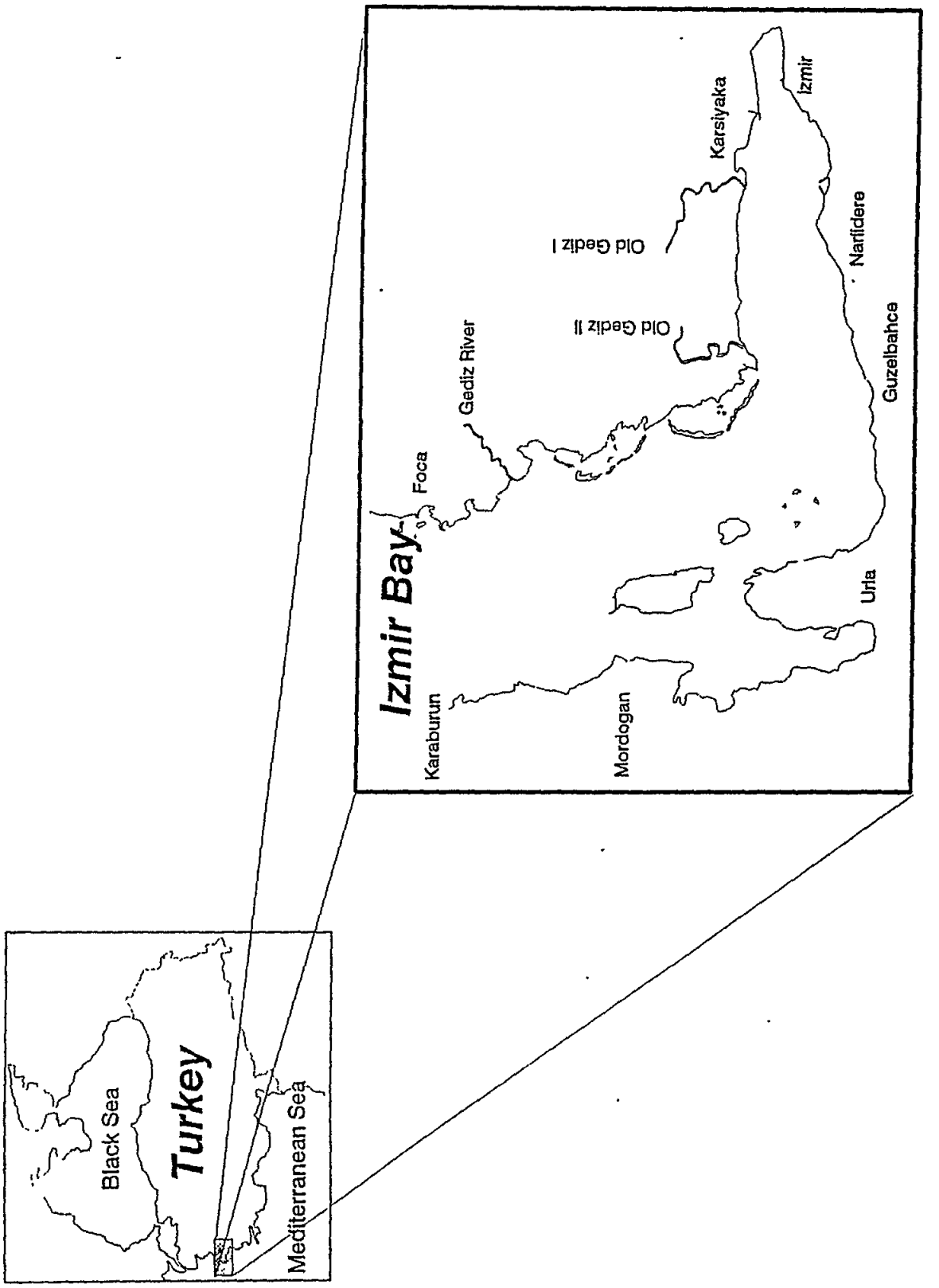

Figure 1. Izmir Bay

Scientific evidence suggests if no pollution control measures are taken immediately pollution in the Bay will reach a critical level by 1995 leading to a collapse in the ecosystem starting in the Inner Bay and gradually reaching the Aegean coast.

The environmental scenario foresees the construction of the sewerage system to collect domestic and industrial wastewater from the whole of the Metropolitan Municipal area. In addition it is assumed that appropriate pollution control systems will be installed in existing industrial establishments and there will be proper stream control to minimize sedimentation and to reduce pollution from agriculture. The scenario would produce a bay with acceptable bathing water quality as well as reduction of other pollutants as foreseen by the various protocols provided. Any further industrial development would have to be controlled to produce no discharge at all.

Costs and Benefits of Future Developments

It was possible to calculate the costs and benefits for two scenarios based on the reestablishment of quality of the Bay's water with tourism development only but maintaining the existing industrial, agricultural, transport and infrastructure of the region. Two scenarios are: one conservative, tourism in the future to develop slower than the expected tourism growth rate for Turkey as the whole; and secondly a progressive scenario, tourism in the region in line with the national growth rate. Other expected benefits included health, fishing, salt production and recreation. In both scenarios the expected stream of benefits, discounted for 1990 values at 8%, exceeded the expected discounted costs. In the conservative scenario the benefits exceed the cost by a factor of one and in the progressive scenario by a factor of eight. The total discounted clean-up costs for the period 1990-2025 would amount to $ 1.5 billion. On the other hand, benefits in the conservative scenario would total $ 4.8 billion ($ 3.4 billion from tourism, $ 0.8 billion from salt production, $ 0.2 billion from recreation); under the progressive scenario the benefits would be substantially higher of $ 10.2 billion ($ 8.0 billion from tourism, $ 1.4 billion from salt, $ 0.4 billion from recreation).

In addition there is the existence value of the clean Bay with its ecology which has a value for the inhabitants and for the nation as a whole but for which no generally accepted valuation exists. Using property prices in similar coastal areas with good water quality, and allowing for differentials in per capita incomes, property prices could double if the Bay's environment is reestablished. This value was estimated for 1990 at $ 10 billion.

Conclusions

The preliminary assessment suggests that the benefits of the proposed sewerage system for Izmir and the implementation of the protocols of the Barcelona Convention could significantly outweigh the costs of the control measures by a factor of one to three. This result is based on tourism led future development of the Bay which appears to be environmentally the least damaging and economically the most beneficial. However other scenarios are also feasible which have not been examined because they are more complex both from the costing and from the benefits side. It must be also pointed out that the calculations on the benefits side because of the time constraints were limited to relatively simplified methods. Wider national implications were also not taken into account as the study was limited to the Izmir Bay region. This study produced only approximative assessment for two possible scenarios and substantial further work is needed to strengthen the results obtained.

1. BACKGROUND

1. The sixteenth (1991) session of the Governing council of the United Nations Environment Programme (UNEP), in decision 16/26 A on "Marine pollution from land-based sources", requested the Executive Director to continue the preparation of elements for draft strategy options and actions to reduce the degradation of the marine environment from land-based activities. The decision also calls on the Executive Director to convene a meeting of government-designated experts to formulate a draft strategy, including a targeted and costed programme of action for reduction of the degradation of the marine environment from land-based sources of pollution and activities in coastal areas, and to complete a targeted and costed action programme for the Mediterranean as an input to the strategy, and as an example for the preparation of an international study.

2. The informal consultation of technical and legal experts (Nairobi, 30 September- 3 October 1991), when reviewing the draft strategy for the reduction of the marine environment from land-based sources of pollution and activities of coastal areas being prepared for the meeting of government-designated experts referred to in the preceding paragraph recommended the preparation of specific detailed case studies on the costs and benefits from the reduction of the degradation of the marine environment, as a supplement to the preliminary estimate of the cost associated with the protection of the Mediterranean Sea.

3. In consultation between the Oceans and Coastal Areas programme Activity Centre of UNEP, the Co-ordinating Unit for the Mediterranean Action Plan (MEDU) and the relevant national authorities, and taking into account the ongoing integrated coastal zone management pilot projects carried out in the framework of the Mediterranean Action Plan, UNEP selected the Bay of Izmir and the Island of Rhodes as the sites of the case studies.

4. An ad hoc consultation was convened by MEDU (Athens, 5-6 November 1991) to launch the preparation of the two case studies which were to be ready for presentation at the meeting of government-designated experts in December 1991. The consultation concluded that due to the time constraints the studies which will be prepared should be considered as incomplete and preliminary only, and would require a follow-up to complete them after the meeting of experts, taking into account the comments and suggestions made by that meeting. Taking into account the comments and suggestions received from the meeting of Experts, the present case study has been completed and was presented, as document, together with methodology used for its preparation to the Consultation on Costs and Benefits of Reduction of the Degradation of the Marine Environment from Land-Based Sources of Pollution, organized by MEDU (Athens, 6-8 April 1992). The consultation reviewed and revised, as appropriate the case study and the present document should be viewed and judged in this context.

2. INTRODUCTION

5. The Bay of Izmir and the surrounding coastal area has been under intensive examination for some time and for various purposes. Early planning for the Metropolitan area was developed at the beginning of the 1970's and this originated a number of assessments including technical and financial evaluations for the construction of environmental infrastructures. Sufficient understanding has also been developed on the nature, quality and relationships between the waters of the Bay and land activities. At the same time significant advances were made worldwide in the economic assessment of the benefits, often expressed as avoided damage, of environmental protection measures. The stage has been reached today, with the international understanding of complex issues in natural resource and environmental management, to be able to evaluate these policies in terms of their costs and benefits.

6. For these reasons the Bay of Izmir is an ideal case for such an assessment. A relatively clearly projected development plan is available; the technical options for resolving the environmental problems are well defined. The moneys required are substantial and there is a need to justify these outlays not only in environmental but also in economic terms.

7. This report is the first step towards such justification. It provides a range of values for economic benefits (avoided losses) arising from the restoration of the Bay and developing it in a sustainable manner. The qualifications attached to this undertaking are presented at the end of the report. However, the authors believe that given the availability of the data, the present state of art in evaluation, the danger of the imminent collapse of the Bay, and the international need for analysis of this type for the other areas of the Mediterranean justify the risks involved. The main risk is the undervaluation of the environmental benefits.

8. The basic terms of references for the preliminary study were;

- the time horizon set for the study should be the year 2025;
- pollutants should include those reaching the environment from coastal land-based sources and activities;
- the reference point for protecting the marine and coastal environment should be the provisions envisaged and the measures decided by the Barcelona Convention and its protocols as well as by the meeting of the parties to the Convention.

The study is based on these assumptions.

3. THE STUDY AREA

3.1. Physical environment: setting and resources

9. The Izmir bay is one of the largest bays in the western part of the Aegean Sea coast of Turkey. It extends approximately 24 km in the East - West direction, with an average width of 5 km. The bay is usually considered to consist of three sections, according to topography and hydrology: inner, middle and outer bays. The inner bay extends from the head of the bay to the Yenikule lighthouse and contains $6x10^8$ cubic metre of water. The middle bay extends to the Kokola point and outer bay extends from Kokola point to the mouth of the bay. The middle and outer bays contain $9x10^8$ and $1x10^{10}$ cubic metres of water. Surface areas of the middle and outer bays are 57 and 417 square kilometres respectively.

10. The water depth in the inner bay changes between 0 and 20 m. Average water depths in the middle and outer bays are 16 m and 49 m respectively. Due to the shallow nature of the inner and middle bays, water exchange and self purification capacities are very limited.

11. On the south shore the land is covered by high hills with steep slopes and there is a narrow alluvial plain along the shoreline. By contrast, the north shore is characterized by low, flat river deltas. However, there is an area covered by moderately sloped hills along the Eastern side of the North shore.

12. The climate of the bay is characterized by high temperatures in the summer and relatively mild temperatures during winter. Average rainfall in the region is 543 mm, 50% of which falls during winter months. Dominant wind direction is SSE in the winter and NNW in other seasons.

13. The Gediz river which flows to the outer bay is the second biggest river in the Aegean region. Its catchment area is approximately 18,000 km^2 and annual average flow from the catchment area of the river is estimated to be $2.33x10^9$ m^3.

14. The inner bay is heavily polluted by nutrients and organic material, but metal concentrations were not high enough to indicate heavy metal pollution. The main source of pollution are streams which flow to the bay and hundreds of small domestic discharge outlets. Very high concentrations of metals, nutrients and organic material were measured in the inner bay coastal stations which are located in the vicinity of discharge points.

15. The middle bay is a transition zone with pollutant concentrations intermediate between outer and inner bays, which is a clear indication of spreading pollution in the bay.

16. Pollution in the outer bay is not significant. Most of the pollution indicators show that, this part of the bay is relatively clean.

17. Fishing, industrial activities, port activities and tourism are the main sources of income for the region.

18. Commercial fishing is an important resource for the area. The information on the amount of catch in earlier years is scarce, but it is qualitatively known as the amount of fish marketed have steadily reduced in last 20 years. Currently the fish stock for commercial fishing and catch levels are estimated to be 217.6 tons/year and 65 - 87 tons/year, respectively.

19. Tourism is another resource for the City of Izmir which entertains numerous tourists who visit a variety of historical settings around the city. Large numbers of holiday resorts which can be easily accessed from the city contribute significantly to tourism input. An international fair is held between August 20 and September 20 every year.

20. A wetland area, the Çamaltì saltpan and Homa weir, located to the north of Izmir is an important habitat for a variety of flora and fauna species. The saltpan and weir cover approximately 800 ha of land, various lagoons, saltmarshes and saltponds. Halophilic plants dominate in the saltpan; reeds and rushes are found in the marshes. Tamarisk is present in the dunes and asphodel, tamarisk, oak, figs and thyme are observed in the hills surrounding the area. Pubfish, loach, mullet, crabs, berbel, eels, meadow frog, green frog, night frog, freshwater tortoise and various water snakes live in the area. 182 species of bird have so far been identified in the saltpan. The major species that rest in the area are flamingo, dalmatian pelican, ruddy shelduck, little egret, spur wing plover, silt and caspatian tern.

21. The Izmir harbour is the second largest port in Turkey. It accounts for 25% of annual exports and 55% of imports of Turkey. The average number of commercial ships visiting the harbour each year is approximately 2,000. The harbour also provides support for a commercial fishing fleet, private boats and to the Navy. The storage capacity of the port is 200,000 tons.

3.2 Development trends: population, economic activities, pressures, etc.

22. The Izmir metropolitan area has experienced rapid population increase which placed an intense pressure on the environment of the bay, housing, infrastructure and social services. The annual population growth between 1965 and 1988 was between 60,000 - 80,000 persons per year. Table I shows the current and projected population of Izmir metropolitan area. The table suggests much larger population growth rates in the future. The current population of the City of Izmir and its 10 municipalities which makes up the urban area is 1,441,000 persons. In the year 2020 the population is expected to be 4,050,000 persons which is a factor of four increase in the population. The total urban area in Izmir is approximately 1.4×10^6 ha.

TABLE I

POPULATION PROJECTIONS

Year	Population
1970	768,719
1975	961,830
1980	1,208,910
1985	1,548,927
1990	1,757,914
1995	1,847,000
2000	2,296,000
2005	2,757,000
2010	3,210,000
2015	3,645,000
2020	4,050,000

23. Within the Izmir region, Karsìyaka, Bayraklì, Bornova, Küçükyalì and Yesilyurt are densely populated zones with population density exceeding 300 persons/ha. Büyük Çigli, Küçük Çigli, Örnekköy, Bornova, Çamdibi, Gültepe, Buca and Karabaglar have population densities between 150 and 300 persons/ha.

24. The diameter of the Urban area which was 4.5 km in 1955 has increased steadily to 8.0 km in 1965, 10 km in 1970, 18 km in 1975, 27 km in 1980 and 39 km in 1985.

25. The population changes together with expected water use trends determine domestic waste discharges to the Izmir Bay. Table II shows per capita and domestic waste discharge projections until the year 2015.

TABLE II

DOMESTIC DISCHARGES OF IZMIR BAY

Year	Specific Discharge (l capita^{-1} day^{-1})	Domestic Discharge (m^3 day^{-1})
1985	156	242,000
1990	175	308,000
1995	197	364,000
2000	217	499,000
2005	237	653,000
2010	256	822,000
2015	275	933,000

26. Izmir Metropolitan Municipality is responsible for urban and rural planning through a Master Plan which identifies the land use practices, pollution densities in various zones.

27. Urban development both legal and illegal is continuing around the bay. This is a reflection of continued high population growth of the area and demand for housing to support the population. There are two main pressures to planned urbanization. One is the illegal housing (presently there are 100,000 illegal houses) in Izmir as a result of illegal construction. The geographic spread of such housing areas are high and can undermine the intended plans for certain areas, including nature conservation. The lack of services such as a sewerage in most of these illegal housing areas is the main problem.

28. The second factor is also related to implications of rapid population growth in the region. At present the Master Plan makes provision for urban development in certain areas; as these areas are filled in, both in terms of absolute numbers of dwellings and population densities permitted, new areas may need to be opened up to cater for continued demand. This could push the urbanization to land which is presently designated for nature conservation or rural land uses. These two factors brings strong pressure on the Master Plan.

29. Industrialization around the bay will be discussed in subsequent sections. However, trends in the industrialization of the region together with the population changes will determine the future of the pollution in the area. Consequently, expected changes in the discharge quantities will be discussed in this section. Currently, 105,000 m^3 of industrial waste water is being discharged to the bay without significant treatment. Discharge of these wastes introduces 116,000 kg of BOD, 55,000 kg of suspended solids, 2,600 kg of nitrogen and 160 kg of phosphorus each day to the bay. Expected changes in these discharges are given in Table III. The table suggests that industrial discharges to the bay will increase by approximately 62% by the year 2015. When this increase is compared with the corresponding increase in domestic waste discharges, it is clear that domestic waste discharges will experience a more drastic increase in the near future.

TABLE III

POLLUTANT LOADS TO THE IZMIR BAY DUE TO INDUSTRIAL WASTE WATER DISCHARGES

Parameter	1990	1995	2005	2010	2015
Industrial discharge (m^3 day^{-1})	105,500	118,000	143,000	155,000	168,000
BOD (kg day^{-1})	116,800	130,000	157,000	170,000	185,000
TSS (kg day^{-1})	55,000	62,000	75,000	81,000	88,000
Nitrogen (kg day^{-1})	2,600	2,950	3,575	3,875	4,200
Phosphorus (kg day^{-1})	160	180	215	234	252

30. Discharges of domestic and industrial wastes to the bay restricts recreational activities. Fishing and swimming is banned in the inner bay. Commercial fishing is also banned in the inner bay.

4. LAND-BASED SOURCES OF POLLUTION AND ACTIVITIES IN COASTAL AREAS CONTRIBUTING TO THE DEGRADATION OF THE MARINE AND COASTAL TERRESTRIAL ENVIRONMENT (MUNICIPAL, TOURISM, INDUSTRY, CONSTRUCTION, MINING, ETC.)

4.1 Inventory of sources and activities

31. Various pollution sources and their contribution to the observed pollution levels are given in Table IV. As shown in Table IV, the main sources of pollution in the bay are domestic and industrial effluents which account for 50% of the observed organic pollution.

TABLE IV

PATHWAYS OF POLLUTANTS IN IZMIR BAY

Pollution arising from domestic and industrial wastes	50%
Pollution due to flood water	15%
Pollution caused by ship traffic and bay activities	4%
Pollution due to erosion	8%
Pollution due to transport of chemicals used in agriculture by surface and drainage waters	10%
Pollution transported by rivers and streams	10%
Others	3%

32. The domestic water discharge to the bay is estimated to be approximately 308,000 m^3 day^{-1} for the year 1990. Since domestic wastes are directly discharged to the inner bay without any treatment, it has significant contribution on observed deterioration of the inner bay.

33. Pollutant loads due to domestic waste discharges in the bay are shown in Table V. Domestic waste discharges are an important source for TSS, organics and nitrogen in the inner bay. With high loadings of suspended solids, nitrogen and phosphorous, domestic wastes are the most important source of pollution, especially in the inner bay. This can be clearly seen in the distribution of faecal coliform in the bay, where concentrations reaches to 38,000 $(100\ ml)^{-1}$ in the coastal stations of the inner bay. This value is two-orders of magnitude higher than limit given in the water quality regulation. The faecal coliform concentrations in the stations not in immediate vicinity of discharge sources are not high due to short survival time of the organisms. The faecal coliform concentrations in the outer bay comply with standards.

TABLE V

POLLUTANT LOADS TO THE IZMIR BAY DUE TO DOMESTIC WASTEWATER DISCHARGES

Parameter	1985	1990
Population	1,548,927	1,757,414
Domestic discharge (m^3 day^{-1})	245,000	308,000
BOD (kg day^{-1})	112,000	131,800
TSS (kg day^{-1})	117,000	158,000
Nitrogen (kg day^{-1})	6,100	12,300
Phosphorus (kg day^{-1})	2,000	3,500

34. Domestic wastes are also the main source of ammonia nitrogen which is the dominating form of nitrogen species (the others being nitrate nitrogen, nitrite nitrogen) and phosphate which originate from detergents, and hence are an important source for eutrophication in the bay, especially in the inner bay. The distribution of the ammonium nitrogen and phosphate in the bay resembles distribution of faecal coliform, with much higher concentrations observed in the inner bay coastal stations.

35. Phosphorus concentrations in the inner bay changes between 0.5 and 14 µg l^1 with highest concentrations observed in the coastal stations. The observed phosphate-P concentrations in the inner bay is two orders of magnitude higher than values observed in clean waters, a clear indication of the role of domestic waste in the pollution of the bay.

36. Izmir is an important industrial centre. The extent of industrialization has increased steadily parallel with population increase, or vice versa. There were 1353 industrial establishments registered to the Union of Industrial Chambers in Turkey (TMMOB) in 1986. This number had increased to 6,000 in 1990.

37. Most of the Industries in Izmir are located in the inner bay region. However, in recent years there is a trend of establishment of new industries outward from Izmir, especially Northwards between Karsìyaka and Menemen and Eastwards between Bornova and Turgutlu.

38. The main type of industries in the region are; food industries, beverage manufacturing and bottling, tanneries, vegetable oil and soap production, paint production, chemical industries, paper and pulp factories, textile industries, metal processing, a petroleum refinery, a petrochemical complex, timber products and processing. Small scale manufacturing of various goods are not included in this list. Among these industries, tanneries, textile plants and paint manufacturing are believed to be the most important contributors to the pollution of the bay.

39. Tanneries are mostly concentrated in the Yesildere and Gökdere zones. In the Yesildere region there are a total of 82 tanneries processing 25,000 hides each year. In the Gökdere 12 tanneries process 5,000 hides per year. Total Leather production of these tanneries are 40,000 tons $year^{-1}$.

40. Wastes of tanneries, which are enriched metals, especially Cr and phenolic compounds are directly discharged to the sea.

41. There are 14 paint producing plants with a total capacity of 155,000 tons year^{-1} in Izmir area. These plants produce various types of paints plus side products such as thinner, varnish, retarder etc. Waste waters from paint industries are known to have high COD, solids, and heavy metals such as Sb, Ba, Co, Cu, Fe, Pb, Mn, Ni, Ag and Zn. Wastes from paint industry also contain toxic organic material which contribute to COD.

42. There are five main textile manufacturing factories in the region. Total production of these facilities is approximately 41,200,000 metres, excluding other products such as various types of threads. In addition to these large plants there are also large number of small manufacturers which are not included in the list. Organic load from these unlisted small manufacturers to the bay is calculated to be equivalent to that from 9,210 persons.

43. A new industrial zone namely "Izmir Atatürk Organised Industrial Region" is planned to be established in the North of the bay. The zone will be located on a 680 ha of land and there will be about 500 individual factories belonging to 18 different industry type. Four large capacity chemical plants with wastes having organic content equivalent to that of 2,500 people will be established in this zone. In addition to these two major textile factories with population equivalents of 4,000 and 2,500 persons, three food processing plants with population equivalents of 2,800, 2,138 and 2,510 persons are anticipated. Another waste with high organic content is from wine production with a population equivalent of 5,716 persons.

44. In addition to these industries which have wastes with high organic content, there are hundreds of other industries which contribute to overall pollution problem.

45. The treatment plant which will be built in the Atatürk Organized Industry Site will have a capacity to remove 5,000 kg/day of BOD and 12,500 kg/day of COD.

46. Total industrial wastewater and pollutant discharges are given in Table VI.

TABLE VI

POLLUTANT LOADS TO THE IZMIR BAY DUE TO INDUSTRIAL WASTE WATER DISCHARGES

Parameter	1985	1990
Industrial discharge (m^3 day^{-1})	93,000	105,500
BOD (kg day^{-1})	102,000	116,800
TSS (kg day^{-1})	49,000	55,000
Nitrogen (kg day^{-1})	2,300	2,600
Phosphorus (kg day^{-1})	140	160

47. When these figures are compared with similar values from domestic waste discharges, it can be seen that, domestic waste water discharges are the most important source of nutrient, solid and organic pollution. However, industries discharge toxic substances which are not found in the composition of domestic wastes.

4.2 Estimate of the type and amounts of pollution, including pollution reaching the marine environment through rivers and atmosphere

48. The main form of pollution in the Izmir Bay are organic pollution, nutrients and toxic material carried by rivers. Although, data to estimate fluxes of these pollutants to the bay is scarce, some estimates of fluxes can be done. Table VII shows, TSS, Nitrogen, phosphorous, Cr, Cd and mercury inputs to bay by domestic and industrial discharges. Total suspended material input to bay is 99,000 tons year^{-1}. Contributions of domestic wastes and industrial discharges on total TSS flux are approximately equal. Total N flux is 5,300 tons year^{-1}, and domestic discharges account for 80% of N flux. Phosphorus flux to the bay is 1,300 tons year^{-1}. Domestic discharges account for 95% of total flux. Industrial fluxes of Cr, Cd, and Hg to bay are 6,700 kg year^{-1}, 20 kg year^{-1} and 70 kg year^{-1}, respectively. Data are not available on fluxes of heavy metal due to domestic discharges.

TABLE VII

DOMESTIC AND INDUSTRIAL FLUXES OF POLLUTANTS TO THE IZMIR BAY

	Domestic	Industrial	Total
TSS (ton year^{-1})	57,700	20,075	77,775
N (ton year^{-1})	4,500	950	5,450
P (ton year^{-1})	1,280	58.4	1,339
Cr (kg year^{-1})		6,624	6,624
Cd (kg year^{-1})		20.4	20.4
Hg (kg year^{-1})		70	70

49. Pollutants are brought to the bay either via rivers or for domestic wastes through hundreds of direct discharge points. Amounts of TSS, nitrogen and heavy metals transported via streams are given in Table VIII. Total amounts of TSS discharged by streams is 29,000 and 440 ton year^{-1}, respectively. These total amounts are substantially smaller than total figures given in Table VII. These rivers carry mostly industrial discharges, but only a small fraction of domestic discharge. Most of the heavy metals are due to industrial discharges, and carried by streams.

TABLE VIII

FLUXES OF DISSOLVED POLLUTANTS VIA STREAMS

	TSS (ton year^{-1})	N (ton year^{-1})	Cr (kg year^{-1})	Cd (kg year^{-1})	Hg (kg year^{-1})
Bostanli Stream	710	7.5	19-73	0.5-1.4	0.7-2.4
Ilica Stream	3,000	33.2	26-100	0.6-2.0	0.9-3.3
Bornova Stream	4,100	23.1	26-100	1.0-2.4	1.8-13
Manda Stream	6,900	131.0	120-210	1.5-3.0	2.2-11
Arap Stream	5,400	59.5	217-790	0.9-2.9	1.3-4.5
Halkapinar Stream	340	3.8	26-100	0.7-2.0	0.9-3.3
Melez Stream	7,300	110.0	440-4,400	1.5-5.1	0.9-23
Poligon Stream	1,300	4.5	5.0-19	0.1-0.4	0.2-0.6
Old Gediz River		61.6	55-210	1.4-4.1	1.9-6.9

50. The table does not include discharges by the Gediz river which discharges 295,000 tons of TSS, 4,900 tons of nitrogen each year. Amounts of pollutants discharged by Gediz river are higher than total amounts discharged by other streams.

51. The particles discharged by rivers contain toxic substances and are an important source of pollution in the bay. Table VIII shows amounts of Cd and Hg carried by streams in one year. Approximately 50% of Cd and Hg flux to the bay is via sediment transport. Data are not available to calculate the role of sediment transport in other pollutants.

Izmir Bay Area Sewerage and Stream Control Activities

52. As can be seen from previous discussions the recovery of the Izmir Bay is possible only by appropriate collection, treatment, disposal of domestic and industrial wastewater and stream control. With this understanding Izmir Sewerage and Stream Control Project started in 1983. The main concept of this pollution control activity is to eliminate the current discharge of untreated wastewater to the bay, by intercepting the whole inner and middle bay, and conveying the collected wastewater to a lagoon wastewater treatment system for secondary treatment, and by effluent disposal to the middle bay through an old river bed, with the option of discharge to the outer bay through submarine outfall as well as proper stream control.

53. The present cost estimates of this undertaking is $ 1.0 billion and includes 53.7 km of main interceptors between the treatment plant site, 95 km of main and 400 km of secondary collectors, 77 km of sewer replacement, 300.000 new sewer collections, 4 large pump stations, individual or joint treatment facilities for several dozens industry complexes, joint treatment facilities for organized industrial sites, and if become necessary disposal of treated wastewater through suitable submarine outfall and finally intensive stream control. Tables V to VI show present and projected wastewater flows.

4.3. Estimated impacts on the natural environment and human activities

54. The list pollutants reaching the Izmir Bay marine environment from land based sources and activities through direct discharges, through atmosphere and riverine transport and estimated impact of these pollutants on the Bay ecosystem and other human activities are given in Table IX.

TABLE IX

PRIORITY POLLUTANTS IN THE IZMIR BAY

POLLUTANTS	SOURCE	EFFECTS	LOSSES DUE TO POLLUTION	CONTROL ACTION	BENEFITS DUE TO POLLUTION CONTROL
Sewage	Domestic and Industrial Effluent	Bathing water quality, fisheries, human health	Tourism, sea food, recreational amenities, salt production	Domestic and industrial treatment, outfalls	Increased recreation, improved health and quality
Nutrient (nitrate and phosphate)	Domestic and industrial effluent, streams and agriculture	Eutrophication, red tide, bathing water quality, human health	Tourism, recreation amenities, fisheries, salt production	Treatment, stream control, outfalls	Increased recreation, tourism, land quality
Sediments	Dredging, stream runoff industrial sewage	Bathing water quality, eutrophication, human health	Tourism, harbour activities, recreational amenities	Stream control	Increased recreation, tourism, health-food quality
Metals (Chromium, Mercury and cadmium)	Industry, e.g. tanneries, domestic effluent, streams	Food quality, effect on microorganisms	Food quality, tourism	Industrial waste treatment, low waste technology	Improved food quality and water quality

5. OVERALL ENVIRONMENTAL AND HEALTH DAMAGE

55. The environment of Izmir Bay is unique: pollution related damages have been accumulating for a long time and the scientific evidence suggests that pollution levels are reaching a critical point. This is likely to happen in the near future and at that time damages will multiply at an exponential rate and the ecology of the Bay will breakdown. When this happens no further pollution load can be discharged into the Bay and on-going pollution will have to be significantly reduced.

56. The fundamental proposition underlying this study is that the benefits of pollution control investments to be undertaken in the Bay can be calculated from the damages occurring already and from those occurring in the future if the necessary investment is not carried out, i.e. if the breakdown of the Bay occurs.

57. The second unique feature of the Bay's environment today is that although significant pollution control investments have been already undertaken they had little or no beneficial impact on the environment so far. The investment schedule of the proposed sewerage system is such, as given in Table X, that the collection and pumping system is installed first but they will not become operational until after the establishment of the treatment plant. However, even though damages continue to accumulate at an increasing rate during this period these are included as potential net benefits in the calculation.

TABLE X

COST ASSOCIATED WITH POLLUTION CONTROL FOR THE RESTORATION OF IZMIR BAY

ACTIVITY	COST ($1000)	REALIZATION TIME
Domestic Wastewater Pump Stations*	65,000	1992
Interceptor, Tunnels, Collectors, Trunks*	130,000	1992-1993
Sewer Construction*	65,000	1996
Wastewater Treatment System	200,000	1995
Land for wastewater treatment plant	38,000	1987
Stream Control	120,000	1998
Industrial Discharge Control Program and Industrial** Pretreatment Facilities	200,000	1998 1997
Submarine Outfall***	120,000	
TOTAL Capital Investment	938,000	
Running Cost of sewer system and other related facilities(per year):		
Treatment Plant	35,000	
Pumping stations and other	30,000	
Industrial treatment and pretreatment systems	10,000	

* Year 2004 flow rates.
** Approximately
*** If the discharge of treated wastewater becomes necessary.

5.1. Valuation Issues

58. There is now a general acceptance that both resource management policies (e.g. investment in the new water supply) and environmental policies (e.g. investment in sewerage plant to improve the quality of inland and coastal waters) should be based on firm economic ground. To set priorities between competing claims (for e.g. more roads, better air or water) requires a cost-benefit framework, an accepted method of evaluation for investment decision making. Such a framework in turn requires the quantification and valuation in economic terms of the environmental damages and benefits. In recent years significant advances have been achieved in these fields and a number of countries today require by legislation the valuation of environmental benefits for investment purposes.

59. The costs associated with resource and environmental investments can be relatively easily defined and calculated and the conceptual difficulties can be resolved. In this report the costs of protecting Izmir Bay are defined as the expenditures needed to undertake investment and the operating and maintenance costs, as set out in Table X.

60. Concerning benefits they can be classified and valued in various ways and there is a certain consensus in the economic profession on these issues. Nevertheless, it is recognised that further progress is needed in some areas such as the valuation of intangible benefits, e.g. landscapes.

61. The analysis of benefits/damages has to be carried out in a number of steps and these were applied to the case of Izmir Bay, as set out in Table XI.

(a) Environmental changes: reduction in the level of pollution of Izmir Bay and improved coastal landscape;

(b) Objects on the receptors affected, human health, markable outputs (e.g. fishery stocks), ecosystem of the Bay, etc;

(c) Elements valued: actual money transactions in tourist expenditures, in market values of salt output of etc; user values for recreational benefits; non-uses values for existence values for the clean Bay and the bird sanctuary; these are used only as memorandum items not included in the comparison of costs and benefits. Thus, the values used were either actual market values or implicit market values such as property prices.

TABLE XI

BENEFITS/AVOIDED LOSSES FROM THE RESTORATION OF IZMIR BAY FOR 1990

ECONOMIC BENEFITS	($ million, 1990 prices)	
	Conservative scenario	Progressive scenario
1. Tourism	45	45
2. Dredging	2	2
3. Fishing-commercial	5	5
4. Salt Production	5	5
5. Underground water	2	4
6. Corrosion	0.5	0.5
7. Recreation		
-Bay	4	19
-Bird Sanctuary	0.5	0.5
HEALTH BENEFITS		
1. Water Use	0.5	1
2. Dredging	1	3
TOTAL (Economic + Health)	**65.5**	**85**
ECOSYSTEM BENEFITS (*)		
1. Bay of Izmir 2. Bird Sanctuary	10,000	

(*) Non-uses or existence values.

5.2 Monetised effects/damage

62. This section deals with the valuation of marketable outputs and valuation of health benefits.

Valuation of Marketable Outputs

(a) Tourism losses: In the mid-1950's the Bay was of high recreational value; using this date as the starting point for tourism in Turkey, the cumulative losses up to 1990 can be put between 1.5 and 3 million tourists or between 9 and 18 million tourist nights. These past losses due to the pollution of the Bay are not taken into account in this study and mentioned here for illustrative purposes only. For the year 1990, the starting point for this study, estimated value of losses from tourism can be put at $ 45 million based on 150 tourists or 900,000 tourist nights lost at $ 50 per night.

(b) Recreation losses occur because the inhabitants of the Municipal Metropolitan Area cannot use the Inner and Middle Bay and have to travel to the Aegean coast for weekend recreation. The assumption is made that between 10,000 and 25,000 cars leave for the coast 25 times during the year (150 kilometres return trip at an average cost of 15 litres gazoline at $ 1 per litre equivalent to $ 15 per trip; total number of trips 250,000 to 1,25 million per year). The total value of recreational trips for 1990 is estimated between $ 3.8 and $ 18.7 million.

(c) Dredging costs are incurred to keep the shipping channels open from siltation. The siltation is largely caused by inappropriate land management practices in the rivershed basins around the Bay. At present two types of costs are incurred: the actual cost of the dredging operation and the health damage caused to workers and to the population from dredging heavy metal with the sediments (for this see health damage calculations). The estimated cost of dredging that could be avoided with better land management is estimated at $ 2 million.

(d) Ground water losses can be attributed to leakages from tributaries, from domestic wastewater and solids, from surface wastewater and interference from sea water. Reduction of pollution in all these sources with the help of the sewerage system and separate industrial treatment would reduce damage to ground water. At present 90% of Izmir water supply is from groundwater. For 1990 losses due to unsatisfactory quality of groundwater is 10 to 20%, equivalent to 27,000 to 54,000 m^3 of water per day. The marginal cost of supplying Izmir with additional water is estimated at $0.2 per m^3. The consequential loss due to pollution of groundwater is $2 to 4 million per year.

(e) Tuzla Bird Sanctuary is at present threatened by the degradation of the Bay. The sanctuary is 36 km^2, inhabited by 3 million birds of 184 different species. One way of measuring the value of present benefits of the sanctuary is by the cost of visits from Izmir, at about $5 per visit. With an estimated number of visitors of 100,000 for 1990 the minimum value could be put at $0.5 million.

(f) Fishing losses are caused by pollution and include loss of shellfish as well as finfish. Pollution has also created unsuitable conditions for aquaculture in the Bay area. Both the quantity of fish caught and the variety of fish species declined, particularly of the highly valued variety. Total value of fishery losses are estimated at $ 5 million.

(g) Salt production losses can become important as today the Bay area produces 1 million tons of salt. Estimated losses can be put around 50,000 tons (or 5% of total production); at today's market prices $ 0.10 per kilo total losses of salt output in 1990 are calculated at $ 5 million.

Valuation of Health Benefits

(a) Damage to human health occurs from Bay water-based activities: swimming, windsurfing, boating and fishing. No such activity is possible anymore in the Inner Bay but they are still practised in the Middle and Outer Bay. The number of working days lost arising out of illnesses associated with these activities are estimated to amount to 10,000 days per year at the cost of $ 50 per day; total cost would come to $ 0.5 million.

(b) Dredging related human health damages are well known. Heavy metals brought to the surface are released in the air and both workers involved in the dredging operation as well as the population can be affected. Number of lives endangered annually can be put at 2 to 5. Various estimates in different countries measured the value of a statistical human life between $ 0.5 and $ 10 million. Using the lower range total damage to human life would amount to $1 to 2.5 million.

5.3 Non-monetised, qualitative effects

63. Society attaches values also to the existence of ecosystems such as the clean water of the Bay with its marine resources and its visual attractions. Similar values can be attached to the Tuzla bird sanctuary with its large bird population. There are however no generally accepted valuation methods for these existence values. For this reason a particular method is used for the evaluation of the ecosystem benefits of the Bay. The calculated figures are not included in the cost-benefit analysis.

(a) The existence value (ecological and aesthetic) of the Inner Bay where most of Izmir population lives has already been severely effected by the present level of pollution and by the consequential loss of quality of life and loss of welfare. Comparisons with other similarly enclosed but relatively unpolluted Bay areas of the world (such as Sydney Harbour) indicate that property prices are significantly lower in Izmir Bay in spite of the high cultural value of the area. Even after allowing for per capita differentials property values could be doubled for the immediate surroundings of the Bay with an appropriate adjustments for suburbs further away. For 100,000 apartments (500,000 inhabitants) a doubling of present prices would amount to $ 10 billion; this might be regarded as an approximate shadow value for the existence of a "clean" Bay.

(b) The ecology of the Tuzla bird sanctuary would disappear together with its bird population if pollution continues to grow. There would be not only a quantifiable economic loss from the reduction in the number of visitors to the area but the disappearance of a major natural asset. At this stage it was not feasible to put a value on this asset.

6. COSTS AND ASSOCIATED RESULTS/BENEFITS OF MEASURES ALREADY TAKEN

64. Even though the state of the Bay is already critical the measures taken so far will not produce significant benefits until 1995 when the treatment plant will come into operation. In the meantime considerable losses are being incurred and accumulated. These losses from 1990 on are included in the calculation of the net benefits. This section brings together the costs incurred up to 1990 together with the proposed expenditures for the rest of the life of the project. In a separate table the value of total estimated benefits (avoidable losses) are also presented together with benefits calculated for the end of the project, for the year 2025.

6.1. Costing Issues

65. In estimating the costs of any major project there are alternative ways of expressing the costs that will finally produce the benefits. The adjustments needed to the actual expenditure figures depend very much on the circumstances; e.g. such as the subsidies or taxes involved or if there is a separate foreign exchange cost. Here in this study these issues have not been investigated and the expenditure figures used are those provided in the various construction estimates for the different projects.

6.2. Approximate magnitudes of costs

66. Total estimated expenditures for the whole life of the project are presented in Table X. These costs cover the whole of the sewerage system with pumping stations, tunnels, trunk collectors, sewer connections and waste water treatment plants together with the cost of land required. In addition there are expenditure costs for controlling sedimentation and pollution from the rivers and from industrial plants. A submarine outfall is included for the possibility that this would be required to maintain the Bay. Total capital cost is estimated at $ 938 million. These costs will be spent over the next 8 years and the realization time for each project is also indicated. There will be in addition annual maintenance and operating costs associated with most of these capital outlays starting from around 1995. They amount to about $ 75 million per year.

67. Expenditure undertaken up to 1990 total $ 150 million including cost of land, tunnel construction and pumping stations.

6.3. Approximate magnitudes of monetised benefits

68. Using the calculations presented in the chapter 5.2 of this paper the total value of avoidable damage is calculated for the Bay area for 1990 and presented item by item in Table XI. These potential benefits, economic and health, are estimated between $ 65 and $ 85 million most of these $ 45 million coming from tourism. The other benefits from fishing, salt production, underground water and recreation are relatively small.

6.4. Approximate magnitude of non-monetised benefits

69. Although existence values are usually not expressed in monetary terms an attempt has been made here to attach values to "Clean Bay". Consequently an estimate was prepared for 1990 of the "existence value" loss of the already highly polluted Inner Bay. This figure is put at $ 10 billion for 1990 based on property values. Arguments have been advanced for and against the inclusion of the existence value calculations into the formal cost-benefit framework. At this stage the estimate is put forward here as a reminder that other than strict economic and health benefits exist and for consideration for any future work of this nature.

70. On the other hand there was no attempt made to estimate the complete loss of the Tuzla bird sanctuary.

6.5. Emerging points

71. The data brought together in this section suggest that already in 1990, based on the assumptions made, significant damages were occurring in the Izmir region. The pollution trends, both measured emissions and water quality measurements show that the quality of the Bay's water, in particular the Inner Bay is declining rapidly together with the deterioration of the coast line.

72. Monetised damages, measured in terms of lost outputs and health losses, are conservatively estimated between $ 45 and 85 million or about the same as annual environmental expenditures in the region. These figures however exclude the losses in existence values due to the deterioration of the Bay. An attempt was made to attach shadow prices to these losses; the estimated value was put around $ 10 billion. The valuation used for this estimate, based on property value differentials, has not so far received general acceptance in the economic profession.

7. COSTS AND ANTICIPATED RESULTS/BENEFITS OF FUTURE MEASURES

7.1. Expenditure requirements

73. For evaluating future costs and associated results/benefits the following assumptions were made:

(a) If no major expenditure programmes were carried out to control domestic and industrial pollution as well as river control, the ecology of the Bay would collapse;

(b) Future benefits of these expenditures can be estimated as the losses avoided through the actions taken (through these expenditure);

(c) Collapse of the Bay, which would cover the Inner, Middle and Outer Bays and the Aegean coast, would effectively prohibit any further discharge into the Bay (describe manifestation of collapse);

(d) The economic and social effects of the collapse would be a total stop to any further economic development and urbanisation until the Bay is cleaned and no further effluents whatsoever could be discharged into the Bay;

(e) The scenario chosen here is to estimate the economic benefits (avoid damages) in a tourism scenario; the reason for this choice is (a) because a future tourism scenario is easier to estimate in economic terms than an industrial or mixed scenario and (b) because the tourism scenario is relatively favourable to the environment;

(f) Population etc. assumptions are the same as given in Chapter 3. It is further assumed that population would grow to 5 million and cost and benefit streams are estimated up to 2025;

(g) Both costs and benefits are estimated in 1990 constant prices and in US dollars using 1990 exchange rates. Certain prices for environmental amenities have been revalued to take into account the relative price changes due to assumed scarcity of environmental "goods";

(h) The estimated stream of future cost and benefit were discounted for the purpose of comparing the totals of these costs and benefits on the same basis i.e. in discounted values. The rate of discount used was 8%.

7.2. Anticipated benefits (monetised/non-monetised)

74. Anticipated benefits over the 35 years up to 2025 will cover the same areas of activities evaluated in Chapter 5 and set against the costs for the period 1989-90 in Chapter 6. These benefits due to the avoidance of the collapse of the Bay include those (a) arising from economic activities, (b) reduction in health damage and (c) ecological and aesthetic benefits. Using various assumptions about prices, broadly accepted by economists working in the fields of resource management and environment, all these benefits have been quantified and valued in economic terms. There could be other benefits and costs which are at present not known and not included here.

Economic Benefits (see Table XII)

(a) Benefits from Tourism

It is assumed that tourist numbers in Turkey by 2025 will rise to 50 to 75 million per year (including domestic tourists) from the present level of 5 million. The share of Izmir Area will be 5 % of this in the conservative scenario and 10 %, the same as today in the progressive scenario. The number of nights spent would remain at 6 nights in the conservative scenario but would increase from the present 6 nights to 10 in the progressive scenario. Value (benefit) would remain 50 dollars per day. For 2025 the value of tourism to the Izmir area is calculated, based on these assumptions, between 750 million and 2.5 billion dollars.

(b) Recreation benefits

Recreation benefits accruing to Izmir residents from the use of the clean Bay will increase with growing population and with the relative value put on environmental benefits. Between 10 to 15% of the population will participate in weekend recreation (0.5 to 0.75 million inhabitants equivalent to 125 to 190 thousand trips, 25 times a year by the end of the period; the value of the individual trip will remain at 15 dollars over time). Recreation benefits are calculated for the single year 2025 between 47 and 71 million dollars.

(c) Visitors numbers to the bird sanctuary

Visitors numbers to the bird sanctuary could be estimated at 500,000 by 2025 at an increased value of 10 dollars per trip. Total value of benefits would amount to 5 million dollars for 2025.

(d) Losses from Salt Production

With the gradual collapse of the Bay salt production would decline and could be assumed that it would cease by the end of the 1990s. Losses will gradually rise from 5 million dollar in 1990 to 160 million in 2000 and stay at this level till the end of the period.

(e) Losses from Underground Water Supply

It was assumed that at present 10-20 % of available underground water resources are unsuitable for the city water supply because of filtration of wastewater from septic tanks etc. into the aquifer. The benefit of the new sewerage system would be to reduce the present and any further potential losses from underground water supply sources. These benefits could be calculated from the additional costs that would be incurred to replace losses of supply. If no action is taken to reduce infiltration it is assumed that 50 % of groundwater supplies, or 135 thousand m^3 per day, will be lost by 2010. The value of this loss is, using 0.2 dollar as the marginal cost of supply, 10-12 million dollars.

TABLE XII

BENEFITS/AVOIDED LOSSES FROM THE RESTORATION OF IZMIR BAY FOR 2025*

	($ million, 1990 prices)
ECONOMIC BENEFITS	

	Conservative scenario	Progressive scenario
1. Tourism	750	2500
2. Dredging		
3. Fishing-commercial	14	14
4. Salt Production	100	160
5. Underground water	10	12
6. Corrosion	5	5
7. Recreation		
-Bay	47	71
-Bird Sanctuary	5	5
HEALTH BENEFITS		
1. Water Use	10	10
2. Dredging	3	5
TOTAL (Economic + Health)	**944**	**2782**
ECOSYSTEM BENEFITS (**)		
1. Bay of Izmir 2. Bird Sanctuary	50,000	

(*) Benefits not discounted.
(**) Non-uses or existence values.

(f) Losses from Corrosion

Assuming a capital value of harbour facilities would rise to annual capital value of 1 billion (including the daily entry of ships and boats) by 2025 and assuming corrosion damage at 10 % depreciation cost, loses from corrosion due to the highly polluted nature of the Bay's water would rise from 0.5 million in 1990, to 5 million by the end of the period.

(g) Fishing Losses

Fishing losses are estimated at $ 4 to $ 5 million in 1990; the improved quality of water will lead to an additional catch of $ 10 million per year in 2025.

Health Benefits

(a) Damage to Human Health (from Water)

It is assumed that the collapse of the Bay will reduce activities, apart from shipping, to a minimum. Consequently they will cease after 1995 but remain at $ 2 million until then. Diseases as a consequence of a highly polluted bay water however are likely to increase. This could lead to a total number of working days lost annually at 50,000 with the total value of $ 10 million.

(b) Damage to Human Health (from Dredging)

Further sedimentation and pollution of the Bay will require increased dredging activities. Assuming that damage to human life will increase correspondingly to 5-10 life endangered. At the cost of a statistical life of 0.5 million the total loss would be 2.5 to 5.0 million.

Environmental Benefits

(a) Existence (ecological and aesthetic) Value of the Bay

By the year 2025 population around the immediate Bay area would more than triple to 350,000 apartments. Leaving the environmental valuation, based on property values the same as in 1990 this would give an 'ecological aesthetic' valuation of 35 billion. A 50 % increase in environmental values, not unreasonable over the next 35 years would provide a valuation of over 50 billion dollars for the clean Bay.

(b) Tuzla Bird Sanctuary

The total loss of the bird sanctuary, 3 billion birds, would mean a significant ecological, existence loss to the region; at this stage it is not feasible to put an estimate on this potential loss.

7.3. Comparison of costs and benefits

75. The purpose of this preliminary study is (a) to demonstrate the application of cost-benefit analysis to the region of Izmir Bay; and (b) to compare the costs and benefits that are likely to occur over the next 35 years, taking into account all the limitations of such an assessment.

76. Concerning the comparisons the calculations show that both costs and benefits will be occurring over the years at very different rates: most of the expenditures will be undertaken at the early stage of the project, ie. before the year 2000, but the benefits will start growing after 2000. To be able to make the appropriate comparisons they, both costs and benefits, have to be put on a common basis using "discounted present values", as they are employed for investment evaluation for both public and private decision making.

77. The rate used for discounting is fairly crucial for the outcome of this type of assessment; a high rate of discount means that benefits that occur in the distant future will be heavily discounted, meaning that they will carry little weight in the final result. This is particularly serious for projects with environmental benefits where the concern is sometimes with future generations. The discount rate can reflect either society's preference; or the rate of return foregone in the private sector, the so-called opportunity cost of capital.

78. The approach taken in this study is a conservative one using a relatively high social time preference rate of 8 %, which reduces the vale of benefits arising in year 2000 to less than half in present values. The rate has been chosen as one specified for public investment projects in a number of countries and being recognised as somewhat biased against long term environmental benefits. In any future evaluation other discount rates should also be tested for the sensitivity of the results.

79. The results show that discounted total expenditures for the whole of the period, 1990-2025, amounted to $ 1.3 billion as given in Table XIII.

TABLE XIII

IZMIR BAY: COST OF POLLUTION CONTROL

Year	Investment costs								Operating & maintenance	Total	Discount.
	Pump	Tunnels	Sewe	Treatment	Land	Stream contro	Industrial control	Submarine outfall			
1988	13	21.6								34.6	40.4
1989	13	21.6								34.6	37.4
1990	13	21.6	10		38					82.6	82.6
1991	13	21.7	10	40			25			109.7	100.9
1992	13	21.7	10	40			25			109.7	92.8
1993		21.8	12	40		24	25			122.8	95.5
1994			12	40		24	25	30	75	206.0	147.5
1995			11	40		24	25	30	75	205.0	135.1
1996						24	25	30	75	154.0	93.3
1997						24	25	30	75	154.0	93.3
1998						24	25		75	124.0	67.7
1999									75	75.0	38.5
2000									75	75.0	35.5
2001									75	75.0	32.6
2002									75	75.0	30.0
2003									75	75.0	27.6
2004									75	75.0	25.4
2005									75	75.0	23.4
2006									75	75.0	21.5
2007									75	75.0	19.7
2008									75	75.0	18.2
2009									75	75.0	16.7
2010									75	75.0	15.4
2011									75	75.0	14.2
2012									75	75.0	13.0
2013									75	75.0	11.9
2014									75	75.0	11.0
2015									75	75.0	9.3
2016									75	75.0	8.6
2017									75	75.0	7.9
2018									75	75.0	7.3
2019									75	75.0	6.7
2020									75	75.0	6.2
2021									75	75.0	5.2
2022									75	75.0	4.8
2023									75	75.0	4.4
2024									75	75.0	4.1
2025									75	75.0	3.7
Total	65	130	65	200	38	144	200	120	1650	3362.0	1326.1

80. These costs then can be compared with the discounted values of monetised outputs and health benefits presented in Table XIV. These values range between $ 4.75 billion and $ 10.2 billion. The main benefits come from tourism and secondly from salt production. On these estimates the costs of the restoration of the Bay are exceeded by the benefits by a significant margin: in the case of the 'conservative' estimate by a factor of eight. These are significant benefit advantages which suggest that even on purely economic grounds there are strong arguments for proceeding with the restoration of the Bay.

TABLE XIV

DISCOUNTED BENEFITS OF RESTORATION OF IZMIR BAY (1990-2025)

ECONOMIC (OUTPUT) BENEFITS	($ million, 1990 prices)	
	Conservative scenario	Progressive scenario
1. Tourism	3412	8034
2. Fishing	133	133
3. Salt Production	843	1372
4. Underground water	70	92
5. Corrosion	25	92
6. Recreation		
-Bay	203	423
-Bird Sanctuary	22	22
HEALTH BENEFITS		
1. Water Use	45	45
2. Dredging	20	45
TOTAL (Economic + Health)	**4773**	**10191**

81. In addition the existence values should be also taken into account which were not included in the calculations above. These values for the final year of the period could be estimated between $ 25 and $ 50 billion.

7.4. Sustainable development prospects

82. Sustainable development is now generally accepted to mean keeping options open for future generations' and developing natural and environmental resources with this objective in mind.

83. In the case of Izmir Bay that implies that the quality of the Bay's water should be kept clean to the level of bathing water quality, certain unique environmental resources, e.g. Tusla Bird Sanctuary, should be preserved, and generally the surrounding of the Bay be developed in harmony with nature, conserving the unique feature of the landscape.

84. These requirements are fairly stringent and will necessitate a coherent and integrated management structure for the whole area (province); a well developed planning mechanism; appropriate finance and the political will to implement the appropriate measures.

85. A number of these element are already in place in the Izmir area: an integrated structure of management is under development but better balance is needed between development and resource management/environment objective and agencies; there is a highly developed planning mechanism for Izmir Metropolitan Municipality; half of the financial resources are already secured; and there is a strong political commitment to the restoration of the Bay. In addition there is also strong public support for the clean-up and conservation of the Bay and surroundings.

86. Although today the quality of the Bay's water is seriously degraded and the Inner Bay is close to collapse the prospects for the recovery are good and sustainable development is achievable in the foreseeable future. More important perhaps, as this report suggests, this development can be achieved on economically justifiable grounds as well as preserving the sustenance of the Bay's and its surroundings ecology. There is however a choice: a high level of industrial development will not be consistent with sustainable development around the Bay. Neither such industrial development will be consistent with touristic development. The scenario that would support sustainable development would be tourism and urban growth around the Bay and the industry at some distance from the coast. This would still allow industry to exploit the transport advantages offered by the Bay but not its use as a receptive facility for waste.

7.5 Emerging points

87. In this section the cost of restoring the Bay and its surroundings were presented together with the likely benefits, avoided damage, for the period 1990 to 2025. The costs (expenditures) and the benefits were expressed in monetary terms. These streams of expenditures and benefits were than discounted to compare them in 1990 values. Certain environmental values, such as the existence values for the ecology of the Bay and for the bird sanctuary, although calculated separately in monetary terms were not included in the discounted values. Although the authors feel that these calculations approximate the values the society might put on these environmental assets, nevertheless they are highly controversial.

88. The net result then is that, given all the qualifications that can be attached to this type of calculations, it could be both economically and environmentally advantageous to undertake the expenditure to clean-up the Bay and to stop any further discharges into the Bay.

8. CONCLUDING STATEMENT AND QUALIFICATIONS

89. The first objective of this preliminary study was to demonstrate the application of cost-benefit analysis to the region of Izmir in order to establish the validity of this approach in the restoration of coastal areas on a wider basis. The outcome of this demonstration can be judged encouraging. The measures needed to restore coastal areas can be clearly defined and their costs established with considerable degree of certainty. Similarly the benefits arising from the expenditures in the Izmir area in most parts are quantifiable and can be valued in widely accepted monetary terms. On the basis of this limited examination a more in depth and wider application of the cost-benefit framework could be recommended for the evaluation of environmental measures in coastal areas.

90. The second issue this study examined is the 'profitability' of the expenditures needed for the restoration of Izmir Bay; that is, would the benefits generated be sufficiently large to justify the expenditures. The answer on this score is also promisingly positive. In the case of Izmir Bay, on the assumptions used, the benefits exceeds the costs by a factor of three to eight. The benefits are even more substantial when 'existence values' are also taken into account. However, there are no reasons to suggest that these results could be generalized for other areas and each case should be examined separately.

91. In assessing the results a number of qualifications should be born in mind:

- the study had to be prepared at an extremely short notice;
- only one type of development scenario, tourism, could be examined;
- this is a limited regional study and national considerations which could change the results were not taken into account;
- further points are mentioned in the next section.

9. LIMITATIONS OF THE PRESENT CASE STUDY AND WAYS OF ADDRESSING THEM

92. Based on this study there appears to be a good cause for adopting the cost-benefit framework for investments in the restoration of coastal areas, in particular for coastal waters. To move in this direction it appears prudent first to strengthen the Izmir Bay study. From these considerations, the following issues become evident:

(a) General Issues:

- there is a need for a more exact definition of the area to be covered by the case study and of the specific environmental questions to be dealt with;
- the question of appropriate discount rate would need to be examined in a wider context for this type of assessment and sensitivity analysis to be carried out with various discount rates;
- a number of development, including conservation, scenarios would have to be subjected to cost-benefit analysis;
- the differences between purely regional studies and those considering the national and even broader international interests would have to be explored.

(b) Cost issues:

- although the cost estimates were based on solid engineering studies, past experience suggests that these could be subject to substantial margins of error and this factor should also be built into the analysis;
- significantly more detailed and additional cost data would be needed to develop alternative scenarios, e.g. an industrial development scenario.

(c) Benefit issues:

- the quantification of the 'output' and 'health' benefits need to be reassessed both for the base year and for the projections;
- alternative valuation methods for these benefits need to be tested;
- the valuation of 'existence values' need to be further explored.

93. These considerations indicate that substantial further work is needed for Izmir Bay to strengthen the results obtained in this study.

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COSTS AND BENEFITS OF MEASURES FOR THE REDUCTION OF DEGRADATION OF THE ENVIRONMENT FROM LAND-BASED SOURCES OF POLLUTION IN COASTAL AREAS

B. CASE STUDY OF THE ISLAND OF RHODES

G. Constantinides

TABLE OF CONTENTS

E X E C U T I V E S U M M A R Y

The subject of this case study is the island of Rhodes. The island has an area of 1400 km^2 located in the southeastern corner of the Aegean sea in the Prefecture of Dodecanese. The resident population of Rhodes is about 100,000 increasing at 2% per year. The coastal environment is the dominant element in the landscape, easily accessible from all inland areas and the resource most utilised for economic development.

The economy of the island is heavily dependent on tourism. Tourist arrivals reached about 1,000,000 in 1990 with the vast proportion of hotel accommodation and service employment concentrated in the northern part of the island around the city of Rhodes. Rhodes earns about $450 million per year from tourism. Agriculture and manufacturing are of very limited significance for the economy and imports meet most of the tourist consumption demand.

Land-based sources of pollution are confined to liquid wastes from **households, tourist accommodation and restaurants**, the **port** and to a limited extent from **manufacturing** activities. The impact on the coastal environment represents a pollution threat rather than a major pollution problem. The main coastal locations affected by land-based sources of pollution threats are : **the bay of Ixia, the port area** and to a lesser extent **the coast of Faliraki**.

The overall environment damage is estimated at around $15.0 million per year, mostly consisting of loss of tourist revenue.

To prevent the spread and increase of the impacts of liquid wastes on the coastal environment and to improve the quality of the Island's environment, the Prefecture of Dodecanese (in Rhodes) has recently undertaken (1988-90) a series of measures and planned a set of future projects for implementation during the next few years (1991-94). The core project undertaken with planned extension phases is the central sewerage system to serve the greater urbanised area of Rhodes.

The total investment cost of all the projects examined in this case study is about $73.0 million. The estimated monetary benefits to accrue from the implementation of these investments is approximately $21.0 million per year. These benefits are both direct (tourist income and cost savings) and indirect (enhanced environmental amenity reflected on property values). There are also significant qualitative benefits which cannot be measured in monetary values.

TABLE I

Investment Cost (excluding annual costs)	**73.0 $ million**
Annual Benefits	**21.0 $ million**
Benefit / Cost ratio	**2.75**

The most important and largest environmental investment undertaken in Rhodes so far to combat sea pollution threats from land-based sources is the construction of key elements of the Central Sewerage System for the greater area of the City of Rhodes. An investment of $24.2 million has been undertaken estimated to create an annual flow of benefits of about $4.3 million. The required investment for the completion of the whole system of $36.0 million will generate an annual flow of benefits which, expressed in monetary values, will approximate $10.3 million.

Notwithstanding the limitations of this case study due to very tight time constraints, a number of important issues are highlighted underlining the relevance of cost-benefit analysis of environmental protection investments and justifying the need for measuring benefits in money values. Cost benefit analysis, despite its shortcomings, can be a useful environmental management tool improving the information base for sound decision-making.

It should be stressed that this case study is incomplete and further work should be pursued to clarify important aspects of the environmental improvement programme of Rhodes, to analyse the benefits of projects planned for implementation and assess the need for and the benefits of additional environmental control measures and policies.

1. BACKGROUND

1. The sixteenth (1991) session of the Governing council of the United Nations Environment Programme (UNEP), in decision 16/26 A on "Marine pollution from land-based sources", requested the Executive Director *to continue the preparation of elements for draft strategy options and actions to reduce the degradation of the marine environment from land-based activities*. The decision also calls on the Executive Director *to convene a meeting of government-designated experts to formulate a draft strategy, including a targeted and costed programme of action for reduction of the degradation of the marine environment from land-based sources of pollution and activities in coastal areas, and to complete a targeted and costed action programme for the Mediterranean as an input to the strategy, and as an example for the preparation of an international study*.

2. The informal consultation of technical and legal experts (Nairobi, 30 September-3 October 1991), when reviewing the draft *strategy for the reduction of the marine environment from land-based sources of pollution and activities of coastal areas* being prepared for the meeting of government-designated experts referred to in the preceding paragraph recommended the preparation of specific detailed case studies on the costs and benefits from the reduction of the degradation of the marine environment, as a supplement to the preliminary estimate of the cost associated with the protection of the Mediterranean Sea.

3. In consultation between the Oceans and Coastal Areas Programme Activity Centre of UNEP, the Co-ordinating Unit for the Mediterranean Action Plan (MEDU) and the relevant national authorities, and taking into account the ongoing integrated coastal zone management pilot projects carried out in the framework of the Mediterranean Action Plan, UNEP selected the Bay of Izmir and the Island of Rhodes as the sites of the case studies.

4. An ad hoc consultation was convened by MEDU (Athens, 5-6 November 1991) to launch the preparation of the two case studies were to be ready for presentation at the meeting of government-designated experts in December 1991. The consultation concluded (UNEP(OCA)/MED WG.32/2) that due to the time constraints the studies which will be prepared should be considered as incomplete and preliminary only, and would require a follow-up to complete them after the meeting of experts, taking into account the comments and suggestions made by that meeting. Taking into account the comments and suggestions received from the meeting of Experts, the present case study has been completed and was presented, as document, together with methodology used for its preparation to the Consultation on Costs and Benefits of Reduction of the Degradation of the Marine Environment from Land-Based Sources of Pollution, organized by MEDU (Athens, 6-8 April 1992). The consultation reviewed and revised, as appropriate the case study and the present document should be viewed and judged in this context.

2. INTRODUCTION

5. The natural environment is often the victim of human activities undertaken to achieve greater production and more efficient delivery of goods and services. Many economic activities, directly or indirectly, fulfil consumption needs, increase productivity and are instrumental in providing the means for better education and health care. All these will be worth less and less if economic growth and policies for economic growth are allowed to damage the environment and degrade natural resources.

6. The drive for economic growth and the fact that the environment is a common resource have for many years motivated investors to use the environment as a free resource and place no value on it. The same factors also blinded decision - makers to measure economic performance irrespective of the state of the environment. If the investment cost of a hotel on the coast does not include the damage to the coastal environment, there is no immediate incentive to economise and conserve this resource.

7. Tourism in general, is a threat to the environment and this is particularly true for the Mediterranean region where the coastal environment is sensitive and tourism is growing. Tourism has, however, gradually brought about an implicit understanding of the value of the environment as an element affecting the quality of the tourist product ultimately influencing tourist revenues and the future markets available for that product. Tourism is essentially an environment-exporting industry.

8. The environment is a qualitative element. Even though it is a very valuable resource still remains elusive to assess in market prices and conventional economic values. There are no direct market transactions recording the benefits society or consumers derive from the environment. There are in some cases indirect indications, guides and implications that economists may analyse to express approximate values for environmental resources and reflect benefits accruing from actions and measures to control the degradation of the environment.

9. This case study is concerned with the valuation of the costs and benefits of measures undertaken in the Island of Rhodes to control the degradation of the coastal environment from land-based sources of pollution. Apart from the severely limited time available for the preparation of this case-study (3 weeks in all) and the usual data problems, the subject matter of the case study is such that imposes methodological constraints relating to the issues outlined above. Placing values on environmental resources and estimating the benefits in money terms arising from measures and projects to control and reduce environmental degradation is difficult and complicated. Yet such benefits exist and are experienced by communities and individuals. It is important to see how far existing information, technical knowledge and judgement permit an approach to the valuation of benefits from environmental protection measures so that it may assist in the effort to move towards better management and increased expenditure for the control of land-based sources of pollution.

10. Rhodes is on the threshold of environmental threat. There are signs of potential pollution problems likely to affect the quality of the coastal environment which is the island's most valuable resource. Damage is beginning to appear, while the authorities of Rhodes responding to the prospect of greater threat in the future have undertaken measures and projects to control degradation of the coastal environment and are planning the implementation of further actions in the same direction.

11. This case study will illustrate some of the problems encountered in the estimation of environmental damage and the practical results of valuing the benefits of measures intended to reduce the degradation of the coastal environment.

3. THE STUDY AREA

3.1. Physical Environment - setting, resources

12. The subject of this case study is the island of Rhodes, more specifically, the coastal area of the island (see Fig. 1). The island has an area of 1400 km^2, a coastline of some 220 km and is located in the southeastern corner of the Aegean sea in the Prefecture of Dodecanese in which Rhodes is the major population and employment centre. The resident population of Rhodes is roughly 100,000 people, increased from 80,000 since 1981, reflecting an annual rate of growth of about 2.2% (Table II). Both in term of population and physical size Rhodes is just over 1.0% of Greece. Tourist arrivals reached 1 million in 1990, double the level of 1983 implying an annual rate of growth of about 10% a year (Table III).

TABLE II

POPULATION GROWTH IN RHODES

1971	66,783
1981	87,945
1991	106,454
Annual average rate of growth	
1971 - 1991	2.35 %

TABLE III

TOURIST ARRIVALS AND HOTEL BEDS

Year	Arrivals	Hotel Beds
1983	536122	31249
1984	697703	32055
1985	780211	33594
1986	722061	37188
1987	777288	39661
1988	759894	40334
1989	803480	42797
1990	981688	45059

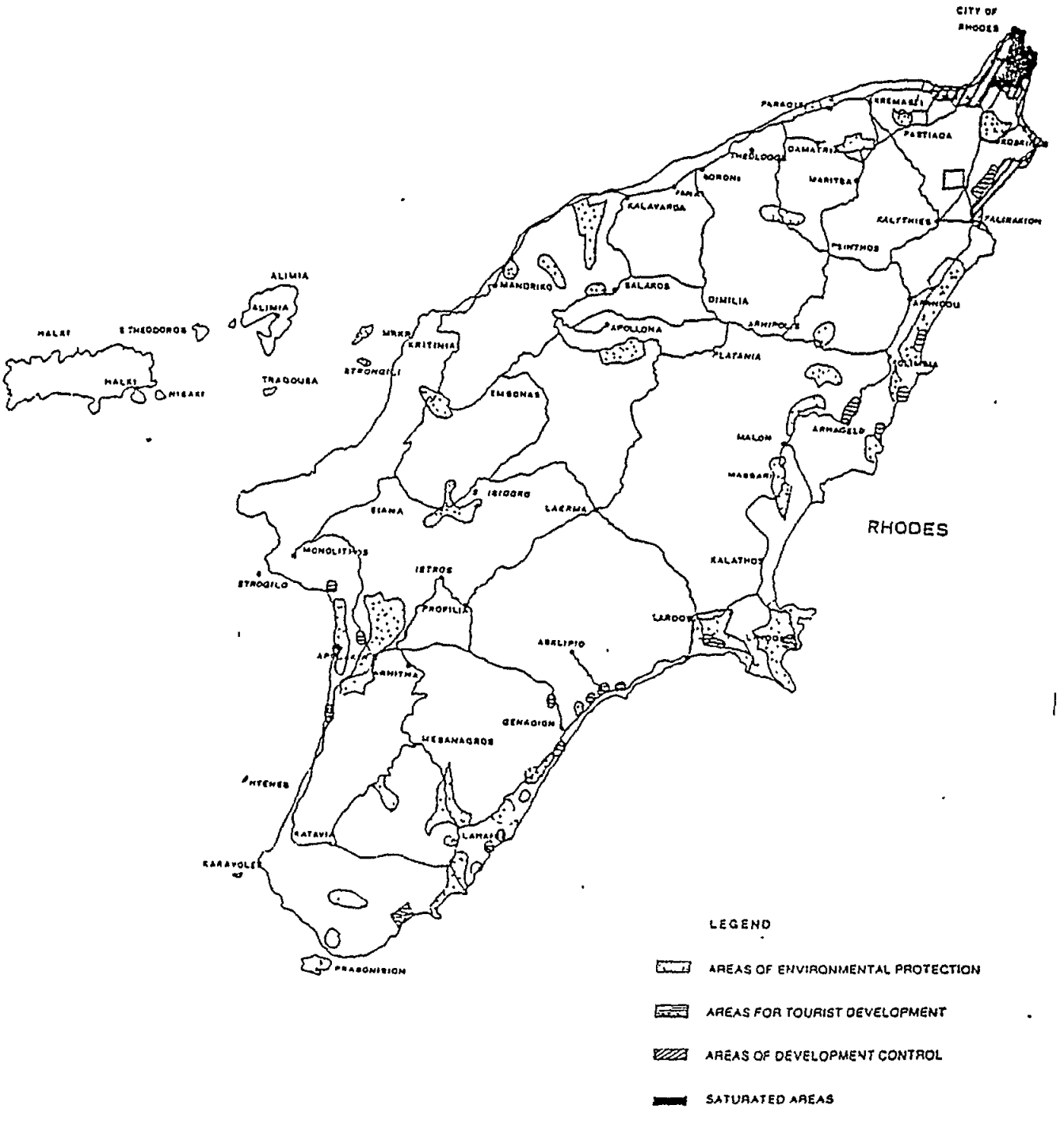

Fig. 1 - The Island of Rhodes

13. The small physical size of Rhodes allows for limited geographical variations, easy mobility and cultural homogeneity. The coastal environment is the dominant element in the landscape, easily accessible from all inland areas of the island and the resource most utilised for economic development.

14. The island's topography is moderately mountainous with hills rarely rising above 400 m. except in the western part where Attaviros mountain reaches 1215 m. The landscape is typically Mediterranean with pine forests, green shrublands and extensive cultivations of olive groves, vineyards and almond trees.

15. The population of Rhodes is unevenly distributed in 44 communities; only 11 have a population of over 1,000 people all of which in the northern top of the island, an area effectively falling within the immediate sphere of influence of the city of Rhodes. The city itself concentrates half of the island's total population. The growth of most of these urbanised communities is significantly higher than the average for the whole island ranging from just over 2% in Afandou to over 4% in Koskinou and Ialyssos, while that of the city of Rhodes lying somewhere in the middle.

3.2. Development trends-population, economic activities, pressures

16. The economy of the island depends heavily on tourism. Tourism growth stimulates significant increase in service employment and rapid urban development with growing concentration of activity in the northern "triangle" enclosing most of the 11 urbanised communities around the city of Rhodes. Of the total of about 40,000 jobs in the island, 16,000 (40%) are in the hotel and restaurant sector and another 10,000 (25%) in the tourist-dependent sectors of construction and trade. Thus, the broad tourist sector accounts for 26,000 jobs, while agriculture and manufacturing employ 6,000 and 3,000 people respectively. The remaining 5,000 are in the public sector. Employment nearly doubled since 1978 reflecting an average rate of increase of about 3.8% a year being significantly higher than the overall rate of population growth but roughly matching that of urban growth.

17. Development trends in Rhodes follow a pattern of over-dependence on the tourist sector which is spatially concentrated in the northern "triangle" of Paradisi-Rhodes-Afandou forming a growth corridor from Rhodes along both sides of the coast. This "triangle" accounts for nearly 80% of the population, just under 80% of employment and almost 100% of all hotel beds. Rhodes earns about $450 million gross receipts a year from tourism. This particular area accommodates all the development activities producing this hard revenue. Furthermore, this area is the focus of further spending from resident households and business enterprises, earning tourist income, as investment and consumption outlets adding to the development pressure on the "growth triangle".

18. Clearly, since agriculture and manufacturing are of very limited significance for the economy, tourism, entertainment, trade and real estate investment are the main avenues for second-round development activities all of which involve construction and higher building densities in the city and on the coastal area close to the city. At the same time, the rising living standard increases the need for and awareness of environmental quality and amenity enhancing expectations for improved public services and environmental management, a perception clearly evident in the current thinking of the authorities and the population of Rhodes.

4. LAND-BASED SOURCES OF POLLUTION

19. Rhodes is by no means a polluted island. But there are identifiable threats in the northern part of the coastal environment justifying concern for the future.

20. Environmental threats are impacts which originate from activities. Naturally enough, the major source of environmental threat in Rhodes is tourism together with the activities which constitute and support this industry, such as construction, transport, entertainment and perhaps to a very small extent agriculture. The study and analysis of the land-based sources of pollution threats in Rhodes, as in many other Mediterranean tourist centres, are particularly illuminating because tourism draws heavily on the resources of the coastal environment and given the foreign exchange earned through tourism justifies the statement that tourism is an environment - exporting industry. Therefore, the need to control the environmental threat from tourism is self - evident for both economic and intrinsically environmental reasons.

21. The domestic sector of the island - the resident urban households - is indeed an important land - based source of pollution threat related to tourism due to the high proportion of the labour force engaged in tourism. In addition to this, the rising living standards of the resident population affords opportunities for increased water and other consumption. It is clear that the population of Rhodes is not prepared to accept environmental degradation as a cost for economic growth. And this will become stronger with further affluence.

4.1. Inventory of sources of pollution

22. For the purposes of this case study the following land-based sources of pollution have been examined :

- Domestic
- Tourist accommodation (and restaurants)
- Transport (the port)
- Manufacturing

The major pollutant relating to the above sources is liquid waste disposal with impact on the coastal environments. Recent studies have indicated that the lack of data on the composition of wastewater prevents any analysis of pollutant loads generated. No examination of the composition and concentration of wastewater has been carry out. Despite this drawback the studies have indicated that the current loads are a threat for the future. Agriculture has not been found to affect the coastal environment. Likewise, solid waste disposal does not pose a threat to the coastal environment while no evidence is available indicating quarrying and construction as a source of impact on the coast. Urban car traffic in the city of Rhodes is an important problem and a source of noise pollution but without negative effects on the coastal environment.

23. As can be seen from Table IV tourism is the main threat at present. The locations of increased threat are confined to areas of high concentration of tourist accommodation and related activity - mainly the bay of Ixia, to a lesser extent the coast of Faliraki and the port.

24. Below are presented the primary locations where present and future pollution control investment in the form of a central sewerage system, is focused.

TABLE IV

INVENTORY OF LAND BASED SOURCES OF POLLUTION

	SOURCE/ACTIVITY	POLLUTANT	IMPACTS	LOCATION
1	Domestic (households)	! Liquid wastes	! Sea pollution threat	! Port area ! Nautical club area
2a	Tourism (coastal) Hotels and restaurants	! Liquid wastes (Sea disposal)	! Sea pollution threat	! Bay of Ixia ! Faliraki
2b	Tourism (city) City seafront restaurants and old city	! Liquid wastes (Sea disposal)	! Sea pollution threat	! Port area
3	Transport (Port)	! Liquid wastes	! Sea pollution threat	! Port area
4	Industry (drinks factories, olive oil production	! Industrial liquid wastes	! Sea pollution threat	! Port area
5	Construction/quarrying	-	-	-
6	Agriculture	-	-	-

4.2. Estimate of the type and amounts of pollution, including pollution reaching the marine environment through rivers and the atmosphere

Households

25. The liquid waste disposal needs in Rhodes are at present served mainly by individual septic tanks for each dwelling (house or block of flats) involving periodic removal of wastes by privately - owned carrying vehicles and final disposal to an artificial pool outside the city. Occasionally liquid waste is discharged underground or into the sea through spontaneous connections to the city's rain-water drainage network. In the city there are two such discharge outfalls, one by the old Nautical Club (Elli bay) and the other at Zephyros near the port. These locations have shown variable amounts of pollution. It is estimated that roughly three quarters of the approximately 14,500 urban households in Rhodes are served by septic tanks regularly emptied by carrying trucks. It may be supposed therefore that about 3,500 households including most of the old city of Rhodes (plus most of the tourist shops and small restaurants near the port) dispose their liquid waste ultimately to the sea.

Hotels

26. The overwhelming majority of hotels in the island of Rhodes are on the coast. About 98% of the 43,000 hotel beds are in and just outside the city with Ialyssos (bay of Ixia) and Faliraki concentrating roughly 20,000 hotel beds. To this number another 3,500 beds should be added in furnished rooms let out to tourists.

Most of the coastal hotels have underground disposal systems. However, roughly about 16-20 hotels, most of them in the bay of Ixia in Ialyssos, operate individual treatment plants for sea disposal. The bay of Ixia and parts of the coast of Faliraki are locations where visible threats to the sea environment are identified. The main source of the threat is the inconsistent performance of the hotel treatment plants resulting in intermittently higher BOD levels than 60 mg/ltr. prescribed by the sanitary authorities. Chemical tests of the treated liquid wastes from hotel plants are regularly carried out since 1984. The results of these tests have indicated no consistent trend towards increasing BOD levels but it is realistic to assume that the individual hotel treatment plants cannot be relied upon to safeguard adequate treatment of liquid wastes and control of sea water pollution in the future.

27. A related pollution source, mostly occurring in Faliraki, is the over-utilisation of ground water sources by hotels resulting in salinisation of ground water on the one hand and overloads of liquid wastes in excess of the designed capacity of the hotel treatment plants preventing adequate treatment. The problem is compounded by periodic hotel extensions and increase in water use.

Transport (the port)

28. As a tourist economy depending on sea and air links for trade with the rest of Greece and other countries, Rhodes has a growing transport sector. The port of Rhodes is a vital centre of activity located in the city at close distance from the old city, the traditional market, the old electricity station and two alcoholic drinks factories. The liquid wastes from the port are a source of sea pollution reinforced by the domestic and industrial wastes from the factories and the old city. Chemical tests in the port area have revealed high levels of BOD while microbiological tests have shown that the area is unsuitable for recreational use.

Manufacturing

29. Notwithstanding the fact that manufacturing activity is limited in Rhodes, there is, however, a source of sea pollution from the industrial liquid wastes of the alcoholic drinks factories near the port.

Agriculture

30. Agriculture is generally declining in Rhodes. The bulk of the tourist consumption demand is met by imports. Despite that, the island's production of vegetables is not insignificant. Production of melons, potatoes, tomatoes, cucumbers and oranges increased since 1984 even though for most of these goods employment and the land area used decreased, clearly implying intensive production techniques and greater use of fertilisers. Intensive agriculture can pollute ground water sources. Also, the increasing use of tunnels for vegetables entails the use of plastic covers which are occasionally drifted to the coast by rivers. This is not a serious source of threat for the coastal environment at present.

4.3 Estimated impacts on the natural environment and human activities

31. The impacts on the environment of Rhodes from land-based sources of pollution are at present more of a threat than real degradation affecting everyday life with consequences for human health. In fact threats arise due to:

(a) the inadequate performance of individual hotel treatment plants,
(b) suspected connections of households and restaurants in costal areas to the sea disposal system of hotels,
(c) suspected connections to the rain-water collection network discharging to the port area,
(d) liquid wastes from manufacturing establishments near the port, and
(e) the general domestic liquid wastes of the city.

5. OVERALL ENVIRONMENTAL AND HEALTH DAMAGE

5.1 Valuation Issues

32. The monetary valuation of environmental damage is a very complicated issue requiring deep investigation, conceptual clarification, time and preparation of indicators enabling approximate values to be placed on environmental quality/damage. On the other hard, it is not impossible or inappropriate to estimate approximate money values for environmental damage using indirect methods when the derivation of such indirect measures of social costs and benefits is feasible given available data.

33. The first step in the valuation process is a matter of observation, that is to identify an environmental damage tracing its origin to an activity (or set of activities). The second step is investigative, to assess the importance of that activity and its spatial pattern and linkages to see how it operates in the economy and its interactions with the environment. The third step is conceptual, to examine if there is a real or a notional market for the observed environmental damage or impact. It is necessary to examine what the society is losing from the damage. This is open to many questions and uncertainty. The valuation itself is the following stage consisting of a series of steps involving manipulation of prices and data in the light of a broad understanding of the social institutions of the country to arrive at the likely estimate of the money value of impacts.

34. This does not mean to say that it is always possible to monetise environmental impacts. Many impacts are qualitative and concern intangible effects.

35. In Rhodes there is a satisfactory level of general information but not in an organised form. Environmental management is a small but growing concern and awareness of information needs enables some correlation between the environment and economic parameters. But there is no adequate information on health, land values in different locations, hotel occupancy rates, house construction on the coast, etc. Estimates had to be attempted of hotel occupancy rates in specific locations, water use, property value changes and of many other useful indicators.

5.2 Monetised effects / damage

36. The valuation of environmental damage in Rhodes is a broad approximation and is meant to be interpreted as a general order of magnitude. The monetised effects are estimated with sensible manipulating of existing information and judgement. The estimated damage refers to five basic categories as they appear in Table IV.

1. Loss of tourist revenue (loss of production)
2. Loss of fisheries output (loss of production)
3. Degradation of the beach (resource depletion, cost of rehabilitation)
4. Human health hazard (cost of treatment)
5. Residential amenity (reduced property values, productivity of land).

Note :The descriptions in the brackets indicate the main valuation principle

37. The estimated monetised effects/damage amount to approximately about $15.2 million. This estimate is within a range of approximation of 25%. The estimated Gross Domestic Product of the island of Rhodes is roughly $500 million. The tentatively estimated monetised environmental damage seems to represent about 3% of the GDP.

38. A general point to stress regarding the monetised estimates of the damage in Table IV (a) is that all values except those referring to the degradation of the beach are annual costs, these costs are incurred every year and in most cases cannot be recaptured. The cost of the degradation of the beach, estimated basically with reference to the financial cost of rehabilitating it, is a capital cost.

39. Summarising the main points of Table IV the following clarifications are relevant:

Loss of tourist revenue

40. Loss of tourist revenue is the largest effect from land-based sources of pollution. It is estimated to amount to about $8.1 million. This damage reflects loss of tourist revenue calculated on the basis of estimates of decline in hotel bed space turnover relating to the pollution threat form land - based sources.

Human health

41. The effects on human health are not significant, estimated at about 0.9 million, representing the smallest effect. Information on the number of tourists visiting the doctor for general skin problems and other complaints was obtained including the cost of treatment. No major problem is evident in Rhodes which can be related to the quality of bathing waters.

Residential amenity

42. Residential amenity is a qualitative concept but some indirect monetary estimates of amenity may be derived through an assessment of the changes in property values, isolated as much as possible from other influences, due to environmental damage. This impact is estimated indirectly by assessing the reduction in the rate of appreciation of property in selected parts of Rhodes with potential environmental threats due to liquid waste disposal. It took into account properties which are retained for residential use whose owners are indifferent to capital gains from potential change of use (tourist, restaurant, etc). This valuation principle is particularly important in Ialyssos (Ixia), in the city centre and in seafront city neighbourhoods near the port.

5.3 Non-monetised effects - Qualitative effects

43. It is unrealistic to attempt to monetise all environmental threats and damage. Some, if not many, impact on the environment cannot be measured in money values because they are intrinsically qualitative and people cannot express how much a particular resource (beauty, coastal amenity, walk along the beach, etc) is worth to them. In extreme cases it should be possible eventually to assess how much the residents of Rhodes would be willing to pay to protect or keep a particular part of the coast in its natural state. Or to assess how much the population would be willing to accept as compensation for a given damage or loss of amenity or loss of option to enjoy open landscape, views, etc. The preferences of future generations are unknown at present but sustainable development requires strategies to allow future generations to enjoy the environment and exercise their options.

44. In Rhodes these qualitative effects are particularly important because the small size of the island renders the coastal environment part of everybody's daily life and changes to the environment have qualitative impacts on the whole community. Links with the past and images of the city and its seafront environment are quality notions affected by tourism. The historical heritage of Rhodes and the high standard of aesthetic and cultural criteria prevailing in Rhodes indicate evident sensitivity to qualitative effects and appreciation of environmental beauty. This sensitivity to environmental standards together with growing awareness of threats to the coastal environment and actual damage shown in Table V have led to actions to reduce the degradation of the environment.

TABLE V

ESTIMATE OF IMPACT ON THE ENVIRONMENT IN MONEY VALUES (in million $)
MAIN PROBLEM AREAS

Area	Source	Activity Involved	SOCIAL COSTS					
			Loss of tourist revenue	Loss of fisheries	Degra-dation of the beach	Human health hazard	Residen-tial amenity	TOTAL
1 Bay of Ixia	Liquid waste sea disposal	. Hotels . Restaurants . Second homes	6.0	N.A.	0.5	0.5	1.0	8.0
2 Faliraki coast	Liquid waste sea disposal/over-utilisation of ground water	. Hotels . Restaurants . Second homes	1.0	N.A.	0.2	0.2	0.5	1.9
3 Port Area	Liquid waste sea disposal	. Industry . Transport . Commercial . Residential	0.5	N.A.	1.0	0.1	___	1.6
4 City of Rhodes	Liquid waste sea disposal	. Hotels . Residential . Commercial	0.6	N.A.	1.0	0.1	2.0	3.7
TOTAL			8.1	___	2.7	0.9	3.5	15.2

6. COSTS AND ASSOCIATED BENEFITS OF MEASURES ALREADY TAKEN

45. The Prefecture of Dodecanese is the administrative authority responsible for planning and implementing the whole development programme for the Dodecanese. The environmental control policy is part of this programme. The Prefecture is centred in Rhodes and comprises almost all the departments corresponding to the appropriate Ministries of the National Administration in Athens.

46. Since 1988 there has been a decisive effort to implement concrete measures in Rhodes for controlling damage to the environment, an initiative which had started earlier with planning and programme preparation activities.

47. In addition to actions initiated by Greek authorities, the Coastal Area Management Programme for the Island of Rhodes (agreement between the Greek Government and UNEP was signed in December 1990) covers in a comprehensive way coastal development and associated pollution. This Programme envisages the full implementation of the Barcelona Convention and its related protocols.

6.1 Costing issues

48. The measures analysed in this case study, shown in Table VI, do not exhaust the entire list of actions undertaken but capture all the important investments of the last 3 years, the period when efforts to reduce land-based sources of coastal degradation assumed some sort of shape. Table VI therefore presents those measures specifically designed and implemented to improve information on land-based sources of pollution and replace the inadequate liquid waste disposal practice responsible for increasing threats to the coastal environment of Rhodes.

TABLE VI

PROJECTS AND MEASURES UNDERTAKEN
COSTS AND ASSOCIATED BENEFITS (in million $)

PROJECT/MEASURE	PROJECT LOCATION	PROJECT PURPOSE	COST		BENEFITS	
			CAPITAL	ANNUAL	SOURCE	VALUE
1. Purchase of equipment and related facilities by sanitary authorities (1988-90)	Rhodes	To strengthen technical management capacities for water quality tests and environment control	0.4		Better information and accurate regular tests for better planning of control measures	Diffuse quality effect
2. Purchase of equipment and related facilities for beach cleaning and meeting sea pollution emergencies (1988-90)	Rhodes	To strengthen technical capacities for controlling solid waste problems on the beach and cope with emergencies	0.25		Cleaner beaches and reduction of nuisance. Readiness to meet emergencies	Diffuse quality effect
3. Sewerage system (collection network and treatment plant) (1989-91)	Lindos	Construction of facility for collection and treatment of liquid wastes to replace existing unsatisfactory practices	1.0	0.1 present value 30 yrs/10% 1.0	Cost savings: • waste removal from tourist houses • construction of on-site tanks Property value increase • land use change • amenity Tourist income	 0.36 0.01 - - 0.10
		Sub-total	1.0	1.0		0.47
		TOTAL	2.0			present value 30 yrs/10% 4.4
						Net present value = 2.4

PROJECT/MEASURE	PROJECT LOCATION	PROJECT PURPOSE	COST		BENEFITS	
			CAPITAL	ANNUAL	SOURCE	VALUE
4. Central sewerage system (1989-91)	Greater City of Rhodes (City-Vodi)	Construction of primary collection network and pumping station	8.5	-	Cost Savings • waste removal from houses	1.5
	City of Rhodes	Construction of part of the secondary collection net	8.5	-	• construction of on-site tanks	0.8
	Vodi peninsula	Construction of part of treatment plant	6.0	0.5 present value 30 yrs/10% 4.8	Property value increase: • land use change	1.0
	Vodi peninsula	Construction of under-water disposal pipe	1.2		• residential amenity	1.0
		Sub-total	24.2	4.8		4.3
		TOTAL	29.0			Present value 30 yrs/10% 40.5
						Net present value = 11.5

6.2. Approximate magnitudes of costs

49. The cost of measures undertaken (1988-1991) amount to about $25.85 million. The measures fall into two categories:

- The **first** concerns relatively small investments for the purchase of equipment ($0.65 million) for the Chemical Laboratory of Rhodes, (for tests of liquid wastes disposed to the sea), and for the Prefecture of Dodecanese for cleaning the beach.

- The **second category** concerns much bigger investments in sewerage construction ($25.2 million). It is noted that the purchase of equipment for the Chemical Laboratory of Rhodes was necessary to enable more regular and wide ranging chemical and microbiological tests according to European Community directives endorsed by Greece in 1986.

50. The cost figures referring to measures / projects listed in Table VI and IV were provided by the Prefecture of Dodecanese. Because of the raw cost figures related to different years, adjustments were made to bring them up to present costs. These adjustments had not distorted the costs since the investments are recent. Costs refer to capital costs with operating costs specified against the appropriate component. Operating costs have not been increased for future years to avoid distortion from inflation keeping them in constant prices, a principle followed also for the benefits. However, both costs and benefits arising in different future years are discounted to bring them all under a common present value. The net present value arrived at through discounting appears at the bottom row of each project.

6.3 Approximate magnitudes of monetised benefits

51. The effort to introduce benefits into the discussion of environmental control projects is the focus of the case study. This effort involves both conceptual and empirical issues. The general approach adopted consists of two related stages:

- First, identification of the sources of benefits arising from the measures undertaken (and the measures to be undertaken) and,

- Second, estimation of the approximate monetary value of these benefits to the extent that this is possible. The first stage is a pre-requisite for the second.

52. As shown in Table VI investment of about $25.0 million is estimated to generate annual benefits of about $5.0 million (with present value of about $45.0 million) yielding a net present value of $14.0 million.

53. The broad approach adopted in this case study for the identification and estimation of benefits is show below citing the framework within which the benefits are classified and analysed:

Sources of Benefits	Direct benefits	
	Increased tourist revenues	! from higher occupancies and higher income markets ! from elimination of the need for periodic removal of domestic liquid wastes by truck
	Cost savings	! from reduced on-site construction costs for septic tanks
	Indirect Benefits	
	Property value increase	! from potential change of use ! from up-graded residential amenity

Direct benefits

54. (i) Increased tourist revenues: This benefit derives from opportunities created by the sewerage system of greater Rhodes to achieve better utilisation of the existing hotel accommodation capacity and to attract higher income amenity-conscious tourists assumed to spend more per head. The measurement of this benefit is meant to reflect incremental values attributable to better coastal environment rather than additional construction of bed capacity. This distinction is difficult to maintain in practice although it is useful to introduce as a concept

(ii) Cost savings: There are two such categories of savings, one arising from reduced household expenditure on removal of liquid wastes by carrying vehicles (minus the sewerage charge which households already pay as a surcharge on water consumption) and the other arising from reduced construction costs for on-site septic tanks (minus the connection fees to be incurred by all households covered by the sewerage system.

Indirect benefits

55. The construction and operation of the central sewerage system will increase property values from two sources: greater potential for change of use and enhanced residential amenity. Measurement of amenity effects can never be complete and accurate and a large part of amenity improvements is basically qualitative. However, amenity does have a positive effect on property values which can be estimated for the purpose of reaching an indirect measure of the impacts of environmental quality. There are quite a few complications due to the fact that property appreciation can and does result from various sources other than the sewerage system. Judgement and relevant information helped in isolating as much as possible the expected increase in property values assumed to relate to the sewerage system from other general factors. Effort is also made to separate the increase in values from opportunities for land use change from that relating to improved residential amenity. It is readily agreed that information on property values and future projections have been less than satisfactory and therefore the monetary measures estimated are at best indicative of general expected trends.

7. COSTS AND ANTICIPATED RESULTS BENEFITS OF FUTURE PROJECTS

56. Future projects considered in this case study are those for which decisions have been taken and technical studies prepared. Other measures regarded necessary or desirable for which no commitments have been made are not included in Table VII. The implementation of projects included in Table VII is envisaged in two stages: The completion of the central sewerage system for the greater Rhodes area during the next 3 years while the other two in the subsequent 3-5 year period.

57. Basically, the implementation programme of actions to be undertaken constitutes the completion of the central sewerage system and the extension of the system to cover the north-western part of the coastal area (Ialyssos) and the connection of the Koskinou suburb to the east.

7.1 Expenditure requirements

58. For the implementation of the projects included in Table VII a total of about $46.0 million will be required, $36.0 million for the completion of the central sewerage system, $8.0 million for its extension (primary collection) to Ialyssos and $2.0 million for the future connection of Koskinou to the main collection networks.

7.2 Anticipated benefits

59. The estimation of the anticipated results/benefits to accrue from the investments planned is highly indicative as repeatedly stressed in relation to the benefits from the projects undertaken. Despite the indicative nature of the monetary measure of the expected benefits, it appears that the benefits will be significant. Over the 30 year period it is tentatively estimated that the completion of the central sewerage system will generate annual benefits of about $10.0 million with net present value (over costs) of about $55.0 million, the Ialyssos extension about $5.0 million with net present value of about $31.0 million and the Koskinou connection about $0.5 million annual benefits yielding a net present value of nearly $3.0 million.

60. Bearing in mind the tentative nature of the estimates, the quality of available information and the uncertainly of many aspects of the measurement of benefits in money values, it may be useful to venture a general comparison of costs and benefits to highlight the importance of looking for benefits when planning environmental investments. Despite all reservations then, it seems that the planned expenditure of $46.0 million can be related to an estimated flow of annual benefits of about $16.0 million (with a present value of about $150 million) yielding an overall net present value of about $90.0 million.

TABLE VII

PROJECTS TO BE IMPLEMENTED
COST AND ASSOCIATED BENEFITS (in million $)

PROJECT	PROJECT LOCATION	PROJECT PURPOSE	COST		BENEFITS	
			CAPITAL	ANNUAL	SOURCE	VALUE
1. Central sewerage system (continuat.) (1992-94)	Greater City of Rhodes	Completion of secondary collection network	26.0	–	Cost savings: • waste removal from houses • construction of on-site tanks	 3.6 - 0.3
	Vodi peninsula	Completion of treatment plant	10.0	0.6 present value 30 yrs/10% 5.7	Property value incr.: • land use change • *residential* amenity	 3.5 3.5
		Sub-total	36.0	5.7		10.3
		TOTAL	41.7			present value 30 yrs/10% 97.0
						Net present value = 55.3
2. Extension of central system (1994-99)	Lalyssos (Ixia)	Construction of primary collection network and connection of local network	8.0	1.0 present value 30 yrs/10% 9.5	Tourism Cost Savings Property value increase	4.0 1.0 0.3
		Sub-total	8.0	9.5		5.3
		TOTAL	17.5			present value 30 yrs/10% 49.0
						Net present value = 31.5
3. Connections to central system (1994-99)	Koskinou suburb-Vodi	Connection of suburban network to main network	2.0	–	Cost savings Residential amenity	0.3 0.2
		Sub-total	2.0	–		0.5
		TOTAL	2.0			present value 30 yrs/10% 4.7
						Net present value = 2.7

7.3. Sustainable development prospects

61. Growing concern for the quality of life and the state of environment has recently shifted attention from economic growth to "sustainable development". Since the publication of the Brundtland Report in 1987, the work of The World Commission on Environment and Development (WCED), the concept of "sustainable development" has come to mean different things to different people. All definitions and discussions around sustainable development focus on the long-term performance of the economy ensuring opportunities for future generations to achieve a satisfactory life. In other words, sustainable development is development which meets the needs of society without compromising the ability of future generations to meet their own needs. In the context of any society this would imply a requirement for preserving all kinds of resources. This is impossible to achieve. A more realistic definition of sustainable development requires that the use of exhaustible resources (coastal, amenity, beach quality, etc.) in development may be permitted when capital resources and new investment compensate for the use of natural resources. Capital resources include assets like sewerage systems which attempt to preserve the state of the coastal environment and protect natural resources from the impacts of human activities thus allowing future generations to exercise their own options. The investments undertaken in Rhodes may be seen as efforts towards sustainable development.

TABLE VIII

COSTS AND BENEFITS OF PROJECTS FOR THE PROTECTION OF MARINE ENVIRONMENT (UNDERTAKEN 1988-91)

COSTS		**($ million)**
1. Purchase of equipment		1.0
2. Lindos sewerage system		1.0
3. Rhodes sewerage system (Phase I)		25.0
		27.0
Plus : Annual Costs	0.6	6.0
Present Value (30 yrs/10%)		
TOTAL COST		33.0
BENEFITS		
Cost savings		3.0
Property value increase		2.0
Tourist income		0.1
Annual benefits		5.1
Present value (30 yrs / 10%)		48.0
Net Present Value		15.0

TABLE IX

COSTS AND BENEFITS OF PROJECTS FOR THE PROTECTION OF MARINE ENVIRONMENT (PLANNED 1992 - 99)		
COSTS		**($ million)**
1. Rhodes sewerage system (Phase II)		36.0
2. Extension of the system (Ialyssos)		8.0
3. Extension of the system (Koskinou)		2.0
		46.0
Plus : Annual Costs	1.6	
Present Value (30 yrs / 10%)		15.0
TOTAL COST		61.0
BENEFITS		
Cost Savings	4.6	
Property value increase	7.5	
Tourist income	4.0	
Annual benefits	16.1	
Present value (30 yrs / 10%)		152.0
Net Present Value		91.0

TABLE X

TOTAL COSTS AND BENEFITS OF ENVIRONMENTAL POLICY IN RHODES ($ MILLION)			
	Costs	94.0	
	Benefits	200.0	
	Due to :		
Direct	Cost savings	72.0	36%
	Tourist income	38.0	19%
Indirect	Property value increase	90.0	45%

8. CONCLUDING STATEMENTS AND QUALIFICATIONS

62. This case study illuminates at least two fundamental issues underlying the whole process of environmental management:

- First, that public sector investment for reducing the degradation of the coastal environment is associated with significant direct and indirect benefits most of which can be estimated in approximate monetary values.

- Second, that despite numerous estimation and measurement problems involved in assessing the benefits of environmental investments, cost - benefit analysis can and should be fully introduced as an instruments for the preparation of environmental management programmes focusing attention on the benefits justifying the required expenditure.

63. When expenditure requirements are presented to decision-makers without projections of anticipated social benefits, misleading conclusions may arise and policy-makers are without adequate information to assign high priority to environmental investments. Investment costs should be compared with the associated benefits which may be increased income, improved quality of life or reduced damage.

64. As the Rhodes case study illustrates, the mounting pressures of growing tourist activity have created environmental costs which interpreted in monetary values appear to run to approximately $15.0 million a year. If no measures were taken environmental costs would increase posing a threat to sustainable development.

65. The most important and largest environmental investment undertaken in Rhodes to control land-based sources of sea pollution is the construction of major components of the Central Sewerage System designed to serve the urbanised area of Rhodes. The components already constructed include: the primary collection network, the first phase of the secondary collection network, part of the treatment plant and the under-water sea disposal pipe. The total investment cost reached about $25.0 million. The completion of the whole system will require an additional investment of $36.0 million, $26.0 million for the remaining collection network and $10.0 million for the treatment plant.

66. As expected, the benefits estimated to accrue from the operation of the system are significant. For the part of the investment already undertaken ($25.0 million) the corresponding benefits are likely to amount to about $5.0 million per year; $3.0 million representing direct cost savings for the households served by the system and $2.0 million representing indirect benefits associated with increased property values (amenity). The investment planned for 1992-1994 for the completion (and operation) of the system ($36.0 million) is estimated to generate benefits of about $10.3 per year of which $7.0 indirect benefits to property values.

67. The usefulness of using a cost-benefit framework to the analysis of environmental damage from land-based sources of pollution is not restricted to the accuracy of monetary estimates because the methodology is not confined to an accounting exercise. Monetary estimates are important but only as indicators of costs to society and benefits to future generations. These concepts together with approximate estimates of what environment resources are worth to people are powerful decision-making tools.

9. LIMITATIONS OF THE CASE STUDY AND WAYS OF ADDRESSING THEM

68. This case study is incomplete in many ways. This is attributed mainly to the extremely limited time available. Field visit to the island of Rhodes was limited to one week, 7-14 November, following a two-day consultation ad hoc meeting in Athens, 5-6 November. During the time available it was only possible to attempt an approach to the range of environmental issues in Rhodes and sketch the measures and projects undertaken and planned. A better grasp of the economic and technical aspects of the projects described in this case study would probably offer opportunities for closer identification of costs and benefits.

69. The limited time available did not allow scope for obtaining more technical, economic and social data on Rhodes necessary for better analysis of environmental damage, the nature of coastal development and on adequate survey of household expenditure, the property market and details of the operation of the central sewerage system.

70. The specification of the sources of benefits and the measurement of the benefits in money terms are therefore based on adequate but very limited information. It is possible that there are additional benefits associated with the existing and future measures identified in this case study and equally possible that the monetary values of benefits presented in this case study are underestimated due to time and data constraints. Even though the essence of the present environmental threats in Rhodes and the salient benefits associated with the projects under way are clearly captured in this case study, more time and data would add to the depth and perhaps to the accuracy of important values and figures supporting the presentation of costs and benefits.

71. To address the limitations of this case study the following actions are needed :
to follow up the work initiated in this case study devoting much more time to the identification and measurement of costs and benefits of environmental management policy in Rhodes. To achieve this objective it is necessary to:

(a) expand the scope of the case study to cover all the aspects of the coastal environment of Rhodes and build up basic socio-economic data relevant to the main environmental problems;

(b) review the short and medium term development options open to Rhodes and assess the role of tourism in promoting/constraining sustainable development;

(c) examine the future environmental investment programme in Rhodes, the administrative and legal capacities for programme implementation and evaluate the financial and resource costs as well as the social benefits associated with implementation.

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