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Consultation on costs and benefits of reduction
of the degradation of the marine environment
from land-based sources of pollution

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PRELIMINARY STUDY ON THE COSTS AND BENEFITS OF MEASURES FOR THE REDUCTION OF DEGRADATION OF THE ENVIRONMENT FROM LAND-BASED SOURCES OF POLLUTION AND ACTIVITIES IN COASTAL AREAS OF THE ISLAND OF RHODES

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EXECUTIVE SUMMARY

The subject of this case study is the island of Rhodes. The island has an area of 1400 km² 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.

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, the Bay of Izmir and the Island of Rhodes were selected by UNEP 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 will have 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. 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.

TABLE I

<u>Investment Cost</u> (excluding annual costs)	<u>73.0</u> \$ million
<u>Annual Benefits</u>	<u>21.0</u> \$ million
Benefit / Cost ratio	2.75

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 km², 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%. 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 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

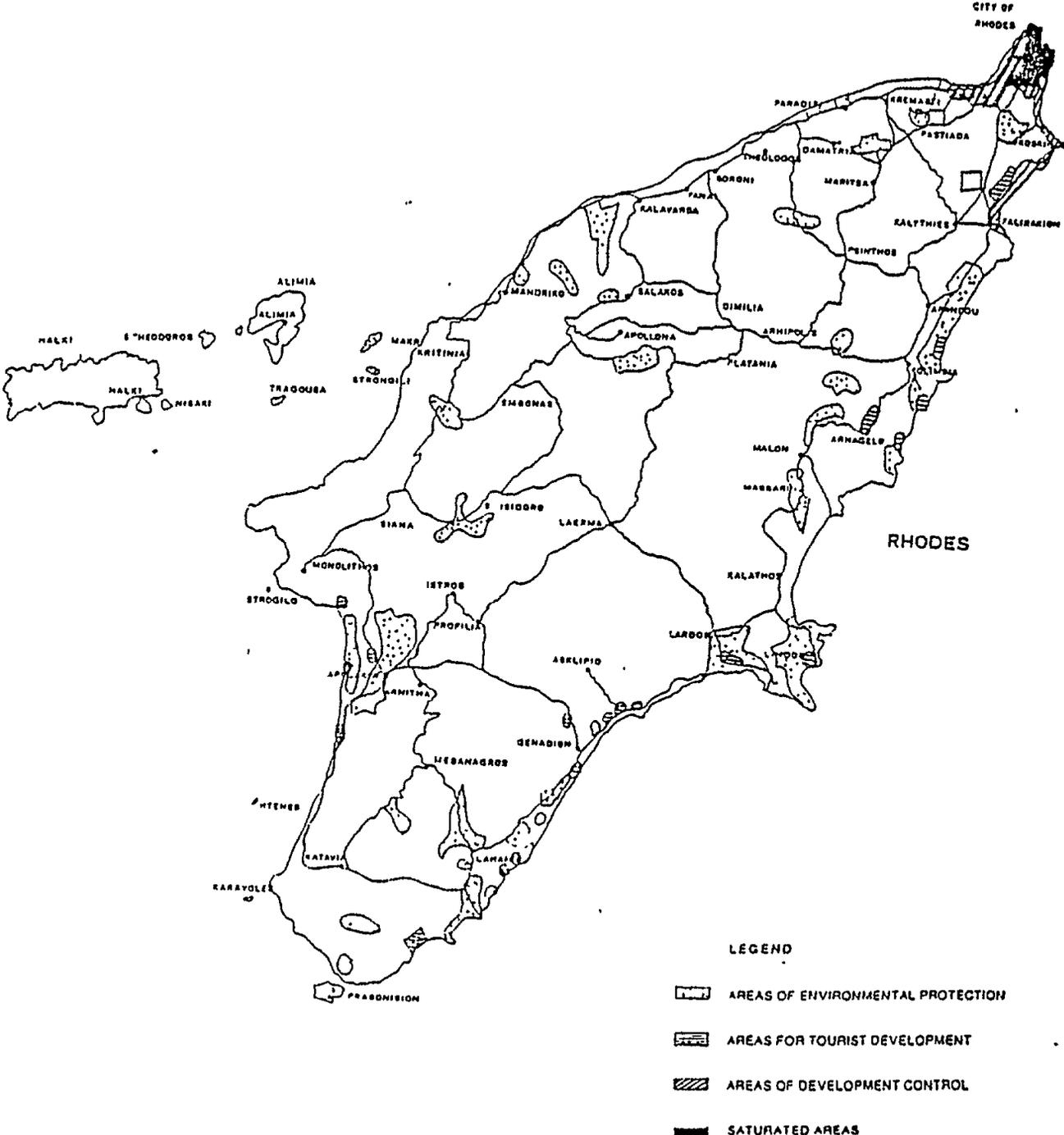


Fig. 1 - The Island of Rhodes

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 lalyssos, 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 lalyssos (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 lalyssos, 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 coastal 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 hand, 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 (a).

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 (a) 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 from 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 Lalyssos (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					TOTAL
			Loss of tourist revenue	Loss of fisheries	Degradation of the beach	Human health hazard	Residential amenity	
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	<u>Cost savings:</u> ! waste removal from tourist houses ! construction of on-site tanks <u>Property value increase</u> ! land use change ! amenity <u>Tourist income</u>	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	-	<u>Cost Savings</u> ! 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	<u>Property value increase:</u> ! 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:

		Direct benefits	
Sources of Benefits	Increased tourist revenues	! from higher occupancies and higher income markets	
	Cost savings	! from elimination of the need for periodic removal of domestic liquid wastes by truck	
		! 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 (lalyssos) 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 lalyssos 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 lalyssos 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 uncertainty 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	--	<u>Cost savings:</u> ! waste removal from houses	3.6
					! construction of on-site tanks	- 0.3
	Vodi peninsula	Completion of treatment plant	10.0	0.6 present value 30 yrs/10% 5.7	<u>Property value incr.:</u> ! 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)	Lalysos (Ixia)	Construction of primary collection network and connection of local network	8.0	1.0 present value 30 yrs/10% 9.5	<u>Tourism Cost Savings</u>	4.0 1.0
					<u>Property value increase</u>	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	0.3
					Residential amenity	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
<hr/>		
		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
<hr/>		
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 (Ialysos)		8.0
3. Extension of the system (Koskinou)		2.0
Plus : Annual Costs	1.6	46.0
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	
Direct	Due to :		
	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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