

Environmental Issues, Social Perception and Coastal Erosion Management: Case Studies from Cyprus

Xenia I. Loizidou ⁽¹⁾, Michael I. Loizides ⁽²⁾

*^(1,2) ISOTECH Ltd Environmental Research and Consultancy, Nicosia, Cyprus
Tel.: 00 357 22 452727, fax.: 00 357 22 458486,
E-mail: info@isotech.com.cy, website: www.isotech.com.cy*

Abstract

Coastal zone is a dynamic environment and each coastal area is a unique natural system. Erosion control should be treated within the framework of an integrated coastal erosion management scheme and as an integral part of an Integrated Coastal Zone/ Area Management Plan. Erosion management is a multi-discipline task. It is not just an engineering problem. Environmental, social and economic parameters should be incorporated in the system, available tools such as EIA, SEA, Fiscal Instruments etc., should be implemented, public participation and civic engagement should be enhanced.

This paper addresses the above issues through the following case studies from Cyprus:

- The Environmental Impact Study for proposed coastal structures in Hrysouhou bay. EIS questioned the engineering solutions which were proposed for combating erosion, something which created conflicts with the coastal engineers, the local authority, the local community and the competent authorities and decision makers. The methodology/approach of this EIA/EIS will be presented in this paper, which was quite innovative for Cyprus, together with a description and evaluation of the conflicting situation.
- The pilot study on social perception for coastal erosion issues in the Dolos-Kiti area, which was prepared within the framework of EUROSION project (pilot study of Cyprus). The assessment of social perception was based on static and dynamic analysis, using existing knowledge and field surveys/questionnaires. The results of the beach users field survey will be presented and discussed in this paper.

- Demolition of one groyne in front of a hotel in Pafos. Work against prejudice that “good” coastal structures are only “hard” coastal structures.

Introduction

Coastal areas are vulnerable and dynamic multi-systems, characterized by continuous changes induced both by nature and human. A series of interlinked, interrelated and interactive systems and processes co-exist at this narrow strip of sea and land: natural processes (biological, physical, chemical), environmental parameters, socio-economic developments.

Coastal erosion is a problem with growing intensity and significance, especially for areas where the coast is an important “development” asset, mainly the areas with tourist activity. Hard coastal structures have been since decades, the remedy for combating coastal erosion. The years proved that in the long run, hard interventions can have serious negative impacts both on coastal morphology and coastal environment. The sustainable development of the coastal areas asks for combining erosion control and good environmental practices, within the framework of Integrate Coastal Zone Management schemes. Often, EIAs/EISs have been proved insufficient in addressing the impacts of coastal protection works to the wider coastal and social environment. Coastal defense and protection structures are usually constructed as emergency measures, without taking into consideration environmental and social impacts.

This paper presents three case studies from Cyprus. The first case study indicates the problems that occur when environmental parameters, through Environmental Impact Studies, contradict proposals for construction of hard coastal works. This created public protest against EIS and conflicts. The second case study presents a survey: beach users were asked on their perception on coastal erosion issues. Social perception is assessed and commented. In both case studies it is clear that people and generally public opinion and decision makers support strongly the construction of hard coastal works, such as breakwaters, as the solution to coastal erosion problem. The third case study presents a good example on how social perception can change when all the data and all alternative solutions are discussed, and when the decision is a matter of participation and shared responsibility.

Case study 1: Environmental Impact Assessment for the coastal protection works in Hrysohou Bay, Cyprus

General information

Hrysohou Bay is located at the north-west part of Cyprus. It is a bay with 38 km coastline length, with rather mild tourist development until now, but with a very high potential and trends for future development. The only coastal structure in the entire bay was a small fishing shelter, located at the centre of the bay. The west 10 km of the bay, is the protected Akamas peninsula, with high ecological importance. No structure is permitted within the peninsula. Hrysohou area is a very important ecological area

(nesting beaches of *careta careta*, corridor of migrating species etc) and an exceptional archaeological site (the ancient Kingdom of Marion) with rich Byzantine heritage. The central part of the bay suffered from coastal erosion most probably due to sand mining and river damming.

In 1998, Public Works Department of the Ministry of Communication and Works decided to ask for out-sourcing and proceed with a study for the protection and improvement of the coast of Hrysohou Bay. The objective of the study was to prepare Master Plans for the entire coastline and detailed designs for a priority area (the central part of the bay), for combating erosion and develop amenity uses in the area. The contract included the execution of an Environmental Impact Study (EIS) from an independent consulting office, in parallel and in consecutive and interrelated phases with the coastal engineering study, so the final decision of the type of coastal protection and improvement works would be based on sound environmental parameters. According to the contract, coastline evolution studies and sediment transport were not part of the EIS. They were included in the Coastal Engineering study.

The EIS: methodology and structure

The EIS was structured in three phases (PROPLAN Ltd (2002)), following the structure of the coastal engineering study:

- *Phase I: Description of the existing situation.* The baseline study on which the Coastal Engineering Study would be based to formulate two alternative solutions/ Master Plans for the entire bay
- *Phase II: Evaluation of the alternative solutions/ Master Plans.* Suggestion of the environmental optimum solution or suggestion of changes and improvements in order to have the optimum solution for the sustainable coastal development of the area
- *Phase III: Detailed Environmental Impact Study.* The Coastal Engineers, after deciding on the final Master Plan through the process of Phase II of the EIS, would proceed with the detailed design of the proposed structures/ works for the central part of Hrysohou Bay, which is a priority area. Phase III of the EIS would be dedicated to the proposals for the priority area.

Phase I: The baseline study

The baseline study, ie Phase I of the EIS, was a very important tool for the work. It provided with information and data on the existing situation and future development trends of the entire Hrysohou area, creating a friendly Data Base. The study consisted of two major parts: the description of the natural environment and of the man made environment, covering both offshore and land characteristics. The *natural environment* was described by providing information and data mainly on the ecology, geology, geomorphology, hydrology and catchment areas, meteorological data and data on coastal erosion, although this last part was not a contractual obligation of the EIS group. *Socio economic* development was described mainly through information and data on the demography of the area, occupation patterns, land-use information, official plans and

trends for the future development of the area, existing infrastructure (eg road network), archeological and cultural sites and the aesthetics of the landscape. The report of Phase I was concluded with a summary of the important assets of the area which should be taken into account by the Coastal Engineers when designing the Master Plans.

Evaluation of the alternative solutions/ Master Plans

The Coastal Engineers proceeded with the formulation of two alternative solutions/ Master Plans for the entire Hrysohou bay, dividing the area into subsections. Both alternative solutions were mainly based on hard engineering approach, in most of the coastal subsections. Alternative 1 suggested a series of detached breakwaters for a coastal length of more than 20 km, from the central to the east part of the bay. Alternative 2 included the series of the detached breakwaters of alternative 1 plus groynes and revetments in some areas. For the protected area of Akamas the suggestion was “no structures” for the largest part of the area and “mild” structures for some parts of this area.

Phase II - Multi Criteria Analysis (MCA)

Multi Criteria Analysis (MCA) was used for the comparison of the two alternative solutions and the selection of the optimum solution. The MCA method which was applied in this project was the method suggested by R. Eastman et.al. (1993) "*GIS and Decision Making*" United Nations Institute for Training and Research. Through the structuring of the MCA, the problem of the selection was clearly defined, which otherwise appeared complex and confusing and the considerations of the selections became more explicit.

Seventeen (17) *criteria* were selected, which have been evaluated as more significant for the area. They have been divided into three categories:

- *Environmental – ecological*: coastal morphology, soil, air, water (coastal water), fauna, flora, community annoyance (eg noise), energy
- *Socio- economic*: land uses, nautical tourism and water sport safety, transport and traffic, public health and safety, public benefits.
- *Cultural – protected areas*: aesthetics, amenity, cultural heritage, historical heritage, protected and to-be protected areas.

The criteria have been homogenised based on local conditions, the strategies were formed and the indexes with the evaluation of the two alternative Master Plans for each subsection of Hrysohou bay have been prepared.

Exclusion criterion

When the impacts on a criterion fall out of the accepted boundaries as they have been set in the study, then the criterion is considered as *exclusion criterion*. One example is the case of the coastal subsection “Aphrodite Baths”. It is the area that according to mythology, the Goddess of Love, Aphrodite, was having her baths in a

cave nearby the coast, which still exists. The coast is a small pocket beach, only 300 meters length, with exceptional natural beauty: rocky cliffs with dense vegetation, and two small pockets of shingle. The Coastal Engineers proposed only one alternative solution for this area: “soft structures”. The EIS group had to clarify with the Coastal Engineers what was the meaning of “soft”. The clarification was: “either submerged breakwaters or construction of wooden jetties”. When running the MCA these two solutions for the coastal subsection of the “Baths of Aphrodite”, were falling within the boundaries of five exclusion criteria: cultural heritage, aesthetics of the landscape, land uses, public interest, protected area. The suggestion of the EIS was to include a third option, the “zero structure” for this subsection. This suggestion was accepted by the Coastal Engineers, and “zero structure” option was selected for that area.

Results of MCA application and evaluation of the alternative solutions/Master Plans.

Suggestions and comments were included for each coastal subsection in the report of this Phase II of the EIS, interpreting the results of the MCA indexes.

The general comments of the EIS to the Coastal Engineers were:

- In most coastal subsections, both the alternative solutions/Master Plans that have been proposed are within the concept of “hard” engineering solutions. The area is a very important archeological and ecological site and the landscape still keeps its natural aesthetics. These are characteristics that should be taken under consideration (Delft Hydraulics (1996)). In addition, the construction of this large number of coastal structures requires large quantities of quarry material, which are not available in the area.

And the specific recommendations were:

- Define present (real) erosion rates. Coastal erosion existed due to some reasons (eg sand mining), which do not exist now. Field measurements are available and they can indicate whether the coast trends to a new equilibrium. If this is the case, the necessity of the construction of this type of coastal protection structures should be reconsidered.
- Review the type of structures. Test more soft engineering approaches, eg test the possibility to shift from breakwaters to systems of berms or wooden decks etc. Try not to change in such extend the aesthetics of the area, the landscape and seascape.
- Check the possibility to adopt fiscal instruments, set back lines etc (Delft Hydraulics (1996)).

The final design – the final EIS phase

The Coastal Engineers proceeded to the selection of the final option for the Master Plan: the construction of a series of offshore breakwaters. The suggestions and recommendations of Phase II of the EIS were not taken into account, except from the case of the subsection “Baths of Aphrodite”. Coastal Engineers proceeded to the detailed design of coastal protection structures in the priority area (appr. 3 km length):

14 offshore breakwaters with the alternative to construct additionally 24 small groynes (10 meters length) and a revetment.

The EIS in this third Phase, suggested to proceed with additional studies and re-examine the proposed structures, since data were missing:

- Sediment transport computations and coastline evolution were not included in the detail design study.
- Erosion trends (present) computations were not included in the study
- The area has a great environmental and ecological importance (eg Akamas peninsula, Limni beach) and historical/ archeological importance, so the type of the works should be reconsidered.
- The aesthetic impact of the suggested solution is significant and should be considered.
- Examine a “lighter” alternative.

Conflicts – social and stakeholder perception

The conclusions/suggestions of the EIS created several reactions, the main of which are:

- The Technical Environmental Committee, chaired by Environment Service and members from 10 governmental departments, was blocked by these conclusions and could not proceed with a suggestion to license the proposed structures.
- Local Authority and local people felt that they are going to miss a chance for an important tourist infrastructure. So they attacked the EIS group through radios, newspapers and in meetings
- Public Works Department together with the Coastal Engineers, felt uneasy from these recommendations, since they would create delays in getting the license for the construction.

The issue is still pending, although the involvement of the EIS group was stopped at that stage. Social perception had an important role in this case. People, locals and decision makers, believe that hard structures are the only solution if they want to have a nice beach, attractive for tourism. The strong evidence that questioned the “hard structures” approach, was introduced through the environmental study. People were not ready to accept the possibility of adopting another development model for their area, more environmental friendly, more sustainable. For years people, including decision makers, have been persuaded that breakwaters are the only solution for the well being of their area. Social perception and environmental considerations seem in this case to have a serious conflict, which blocked the entire process. It is a long process for public opinion and decision makers to agree with the effort not to block development, but through sustainability to achieve a better quality of development. Awareness raising strategies and well structured participation schemes are of significant importance.

Case study 2: EUROSION – field survey on social perception

EUROSION (www.euroasion.org), an EU funded project dealing with coastal erosion, introduced the socioeconomic parameter into the erosion management system.

Cyprus was involved in Work Package 3 of EUROSION, the target of which was to locate pilot sites around Europe which suffer from coastal erosion, document the practices, the policies and the methods which have been implemented and focus on the lessons learned. Among other issues, the assessment of social perception concerning coastal erosion, erosion control and beach use, was an important parameter of this pilot study.

Cyprus participated in WP3 with the pilot site Dolos-Kiti (X.I. LOIZIDOU (2002)) , a coastal area located in Larnaka District, with a 36 km coastline. There are 10 villages in this coastal area, with a total population of 9173 and several conflicting uses like industry, tourism, agriculture and aquaculture. The coast is in general relatively low and flat, and it is mainly characterised by accumulations of gravel and pebble and few tiny poor sandy beaches. The area suffers from severe erosion which in some areas reaches about 0,5 m/year. The land uses of the coastal area have been mainly agricultural until recently, when, by a reform of the Town Planning regime, most of the agricultural areas have been characterised as tourist or development areas. This led to a sudden increase of pressure for tourism and real estate development. Eventually the problem of beach quality became very important and efforts started to combat erosion, either legal or illegally.

Social perception

The description of the methodological approach to assess social perception is coded below, as included in the relevant set of directions of EUROSION group: *“The initial step was a static analysis that feeds from the bibliographic sources related to theoretical and empirical knowledge on the physical phenomenon, socio-economical characteristics, action taken on the environment and the legal context governing the area under study. In order to put all this knowledge into movement and to generate dynamic results in terms of social perception and knowledge of local information and communication, the mechanics for survey, based on a questionnaire about the social perception of the problem of erosion currently affecting the coast, is set up”*.

The evaluation of social perception was based on two pillars:

- ✓ the analysis of information of the pilot coastal area. Four levels of parameters have been identified: Policy Level, Physical Level, socio-economic context and Technical Level
- ✓ a field survey of 200 beach-users and 30 territorial agents/ stakeholders (administrators, officials, experts, economic sector, social groups). The results of beach users survey are presented in this paper. The sample of beach users interviewees was selected according to the following method: *“....the starting points of the racetrack must be chosen randomly at the edge of the sand and a zig-zag route traced toward the water, trying to cover the whole beach. The questionnaire should be given to the 5th person along the route, making sure that there is a minimum separation of 5 meters between each one in order to avoid collective responses....”*

Description of the survey locations for beach users interviews

Four main criteria were implemented for the selection of survey beaches along the 36 km coastline of the pilot area:

- Living beaches known to users, mainly used by locals, who have knowledge on the beach evolution through-out the years
- The coastline has been or still is, under erosion
- The beach is used for amenity reasons
- Hard coastal structures have been constructed in the specific area

Five coastal areas were selected according to the above criteria. Each of them had a peculiarity, a specific characteristic:

- **Agios Theodoros** is a recently protected beach. Two high groynes, 70-meters length created a small 100 meter “pocket beach”. No facilities available.
- **Alaminos** is an open beach, 1 km long, recently protected by offshore breakwaters, which were still under construction when the survey took place. A 5 star tourist village was going to be constructed on the coastal land (in operation since 2005). No facilities were available at the time of the survey.
- **Mazotos** is a camping site. The beach is protected by two groynes which have been constructed 20 years ago. The quality of the beach is not particularly good, due to trapped seaweed (*posedonia oceanica*). Some facilities available.
- **Pervolia** beach is an eroded open beach, 10 km long, without organized and effective coastal protection.
- **Faros** beach is a sandy, wide beach (more than 20 meters width of sand). The beach was created after the construction of an offshore breakwater 20 years ago. The breakwater is located at the east end of the survey area. There are some facilities.

A summary of the most interesting results coupled with comments is presented in the following pages.

Questionnaires

The questionnaires about the social perception on the problem of coastal erosion currently affecting the coast, were set up. They were structured in four groups of questions: *Physical and morphological aspects*, *Environmental aspects*, *Facilities and Services* and *Design and Comfort aspects*.

Physical and morphological aspects

Twelve parameters (see table 1) composed the physical and morphological aspects group of questions.

The colour of the sand	Slope into the water
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The texture of the sand	Waves
Water temperature	Sand temperature
Width of the beach	Wind
Length of the beach	The presence of rocks
Sloping of the beach	Division using breakwaters

Table 1: “physical- morphological aspects”

There was a pattern in all the answers of the beach users on physical-morphological aspects: beach users were giving high scores to the areas where coastal defence structures have been recently constructed (eg Alaminos and Agios Theodoros), ie they liked the new character of the beach. The profile of the beach users is important in order to have a correct analysis of the results: they have been mainly people who knew the areas for years. Therefore, they were comparing the present situation with the previous, before coastal protection, when there was a great difficulty even to have access to the sea through the eroding cliffs.

The second “best” beach in ranking according to the physical- morphological characteristics was the beach of Pervolia, where erosion is still active and no coastal defence structures have been constructed. Pervolia is a long and not at all crowded beach. So, a possible explanation for this “score” could be that the few beach-users of this beach are people who like gravel beach and also like the absolute natural aesthetics of the beach. These people have chosen Pervolia for their swimming so they are happy with their selection.

An interesting result in this group of parameters is the opinion of the interviewees for the use of breakwaters for coastal protection from erosion. The relevant question in the questionnaire was “division using breakwaters”. Beach users of **Alaminos**, the area with recent coastal protection works, had the higher score of acceptance of the breakwaters. It is an expected result, according to the reasoning already mentioned before, i.e. the breakwaters stopped erosion, created accretion and beach is becoming pleasant to be used for amenity reasons.

In the case of Pervolia, a beach without costal structures, the question was put hypothetically, i.e. “would you prefer to have breakwaters on this beach”. Although the beach users were generally satisfied from the physical-morphological characteristics of this beach, they would like to have coastal structures for the improvement of beach quality.

The users of **Faros** beach didn’t like breakwaters, although this beach has been artificially created after the construction of the offshore breakwater in 80’s. It seems that it is not so obvious to the beach users that the beach they are swimming is a result of the accretion caused by the breakwater which is situated 100 meters away. Beach users were very satisfied with the beach and they wouldn’t like to have a breakwater in front of them. It is important to see some critical characteristics of beach users’ profile in Faros, which help in better understanding the answers:

- about 20% of beach users were foreigners - tourists who visit the beach for the first time. In the four other survey beaches this percentage varied from 6% (Mazotos) to 0% (the other 3 areas), where almost all beach users were locals

- the average age of beach users in Faros was 29 years old, i.e. young people. The breakwater had been constructed in 80's, so even young local people do not remember the area before the construction of the breakwater. They consider the sandy beach of Faros as natural beach and they wouldn't like to see any breakwaters in this beach.

Design and comfort aspects

Table 2 includes the four parameters that composed the Design and Comfort group of questions:

Composition of the landscape
The comfort of the beach
Quality/price ratio
The number of users

Table 2: “Design and Comfort aspects”

All five survey- beaches had a positive score in this group of parameters. Agios Theodoros and Faros had the higher scores. Once more, this has to be analysed according to the pattern described in physical and morphological aspects: in Agios Theodoros, coastal defence structures have been recently constructed, beach users, who are mainly locals, appreciate the changes and the new comforts they have. Faros, an area with a wide sandy beach and a breakwater in a distance, is a beach that satisfies the users.

Remarks

Social perception is based mainly on comparisons and experiences: what people knew in the past and what they see now, what they've seen in other areas and what they would like to have. According to this study on social perception, people like hard engineering structures for combating erosion. However, they are not given any other alternative. The dilemma they have is “either breakwaters or beach erosion” and thus their answer is straightforward.

Case study 3: demolition of a groyn in Pafos

The owners of a 5 star hotel in Pafos, had serious problems with the quality of the coast in front of their hotel: almost a lagoon, packed with coastal structures: two offshore breakwaters in a distance of 70 meters from the coast and three groynes. The coastline was rocky and water quality had been significantly degraded. Beach and coast is public in Cyprus. Individuals can apply for interventions and they can pay for studies and structures, provided that the studies will be licensed and public will have free access to the beach. The coastal engineering study was undertaken by private consultants and the EIS by an independent Environmental Consulting office.

The study proposed: the demolition of part of the groyne at the middle and the construction of wooden decks, in order to increase the capacity of the beach for amenity uses and provide with easy access to deep waters for swimming. The EIS (ISOTECH Ltd, (2004), supported the engineering suggestions.

Social perception

People do not accept easily demolition of structures. They prefer construction. The Consultants had to support in a documented and strong way their suggestion to the hotel owners and later to authorities and to public. The reactions were the following:

- The owners of the hotel were desperate with the quality of the coast in front of their hotel. At the same time they had worries and reservations on the suggested solution for demolishing the groyne. However, since the consultants insisted that this would be the best solution, they accepted to pay for it.
- Municipality of Pafos was very dubious on the results of such a demolition. They were discussing on the study, but they did not protest.
- Environmental NGOs supported the suggestion.
- Tourism professionals, such as water sport rentals, strongly protested. They need the groynes for having their facilities on them
- Competent authorities gave the license, after the presentation of the EIA.

The demolition of the groyne was completed on January 2007. In less than 3 weeks, the rocky beach was covered by sand. The Hotel owners were very satisfied. The Mayor visited several times the area to check the evolution of the beach. The issue was discussed among the locals. A new perspective appeared: there are methods to improve a beach other than constructing breakwaters. Coastal Engineers and Environmental Consultants worked together, documented their suggestions, discussed a lot and for a long time with stakeholders (METAP (2002)). This approach had direct impact on stakeholders perception.

Conclusions

A more strategic and proactive approach to coastal erosion is needed for the sustainable development of vulnerable coastal zones and the conservation of coastal biodiversity, suggests EUROSION, and erosion management does not compromise safety, important environmental values and natural resources (EUROSION (2004), A Guide to coastal erosion management practices in Europe)

The trend in EU, especially after ICZM Recommendations and the suggestions of EUROSION is to avoid hard structures when they are not urgently needed and implement integrate approaches. Social perception (including decision makers' perception) is not in line with the above trends. Non-traditional actions like erosion management and ICZM are still unfamiliar to people and frequently resisted (UNEP/MAP/PAP (2001)). Locals, especially in Mediterranean, want to have massive tourism development, which gives quick profit. Inappropriate policies, inappropriate management schemes and infrastructure failed to make sustainable development an effective option. Civic engagement has to be activated within the process of coastal

erosion management and ICZM for the success of the implementation of sustainable and acceptable solutions in eroding beaches. Awareness rising coupled with appropriate policy decisions should be strengthened. Coastal erosion needs a policy perspective, proactive and integrated approaches, not just engineering solutions.

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