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ENVIRONMENTAL ISSUES, SOCIAL PERCEPTION AND COASTAL EROSION MANAGEMENT: CASE STUDIES FROM PAPUA PROVINCE

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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 muti-discipline task. It is not just an engineering problem. Environmental, social and economic parameters should be incorporate 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 Papua Province. The Environmental Impact Study for proposed coastal structures in Southern coastal of Papua Province. 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 Papua Province, together with a description and evaluation of the conflicting situation. The pilot study on social perception for coastal erosion issues in the Southern coastal area, which was prepared within the framework of regional project (pilot study of Papua Province). 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. .

Keywords: coastal, Papua Province, social, economic

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

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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 Papua Province. 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 Southern coastal of Papua Province

General information

Papua province has 45,510 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 coast was a small fishing shelter, located at the centre of the coast. The west 10 km of the coast, is the protected sorendoreri 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 coast suffered from coastal erosion most probably due to sand mining and river damming.

In 1998, Pubic 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 Southern coastal. 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 coast), 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

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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 coast
- *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 Southern coastal, which is a priority area. Phase III of the EIS would be the 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 (Rizal et.al., 2017; Rizal et.al., 2018; Rizal et.al., 2019).

Evaluation of the alternative solutions/ Master Plans

The Coastal Engineers proceeded with the formulation of two alternative solutions/ Master Plans for the entire Southern coastal, 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 coast. Alternative 2 included the series of the detached breakwaters of alternative 1 plus groyns and revetments in some areas. For the protected area of Sorendoreri the

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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 Rizal and Nurruhwati (2018) *"GIS and Decision Making"*. 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 Southern coastal 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 clarificaiton 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

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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):

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 he chosen randomly at the edge of the sand and a zig-zag route traced toward the water, trying to cover the whole beach. The*

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questionnaire should he 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.

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.

Conclusion

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.

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- 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.

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