

CAMP “KAŠTELA BAY” Croatia

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1. DESCRIPTION OF THE AREA

1.1. General

A wider area of the Kaštela Bay, covering the municipalities of Split, Solin, Kaštela and Trogir, is the largest one on the Croatian coast (Fig. 1). It represents an economic and territorial unity, with the city of Split as the dominating centre. The city of Split is the second largest city of Croatia and the administrative centre of the County of Split-Dalmatia. The Kaštela Bay is located at the central part of the Croatian coast on the eastern part of the Adriatic Sea (Figure 1.). The study area encompasses the Kaštela Bay and the neighbouring Split and Brač Channels, as well as the associated coastal strip. The coastal plain around the bay is rather narrow (1-3 km) covering approximately 14,500 hectares, with a high-mountains region in the immediate hinterland. The bay is oval shaped and is enclosed by the Split peninsula in the south-east and the island of Čiovo in the south-west. The island of Čiovo is rocky and hilly, while the Split peninsula is smooth and ends in the Marjan hill. The main entrance into the Bay is between the Split peninsula and the island of Čiovo, while a smaller one is between the island of Čiovo and the mainland in Trogir. The Brač and Split Channels lay between the mainland and the island of Brač, and the islands of Čiovo and Šolta, respectively. The climate of the area is of the Mediterranean type, characterised by dry summers and wet winters. Average annual air temperature is 16°C. The long-term annual average rainfall is 837.2 mm. Geologically, the area forms part of a large Cretaceous-Tertiary sedimentary complex, which belongs to the structural unit of the Adriatic cretaceous carbonate sediments.

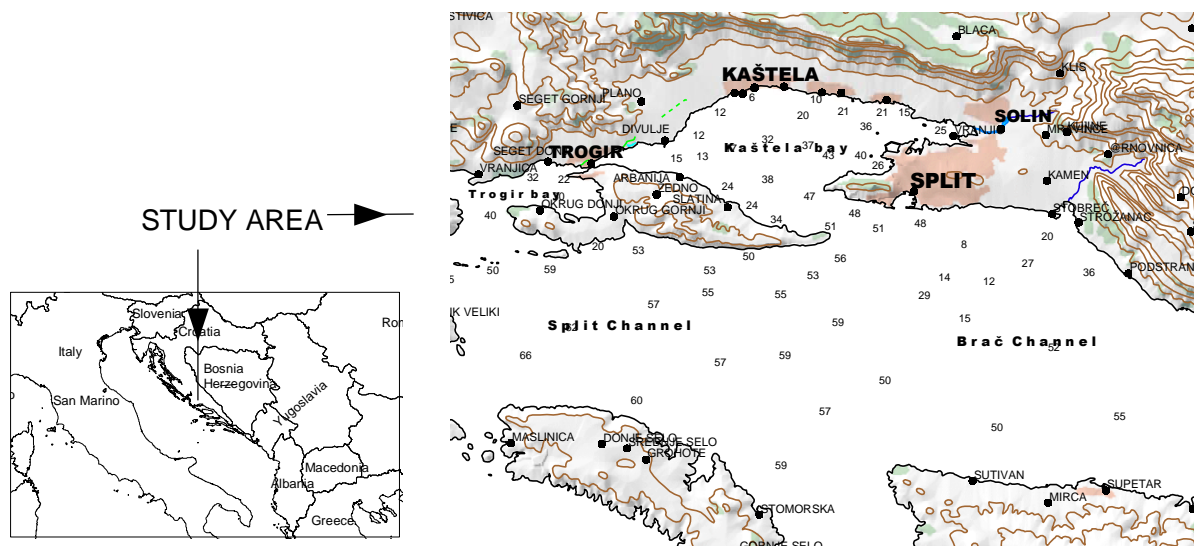


Figure 1. Position of the area of interest

The natural vegetation of the area was evergreen forest, dominated by holm-oak. The Kozjak mountain ridge and higher Mosor slopes were covered by sub-Mediterranean deciduous forest. Now there is a changed vegetation cover. The coastal plain has become almost completely covered by houses and agricultural areas, while steeper slopes are covered mainly by secondary vegetation of scrub, or have completely denuded surfaces. There are two small typical karst rivers in the area: Jadro, located in the eastern part of the Bay with average

annual discharge of 9.5 m³/s (average minimum flow is 4.0 m³/s, and average maximum flow is 66.0 m³/s), and Žrnovnica in the easternmost part of the study area with average winter flow of 5.0 m³/s. Both rivers are used as fresh water sources for the entire area.

1.2. Socio-economic conditions

The total population of the narrow coastal area has tripled over the past half a century, reaching 284,000 inhabitants in the year 1991, while the estimated population for the year 2015 will be 355,000. Split is the second largest town of Croatia. Its population is about 192,000 inhabitants in accordance with population census from 2001. In the eastern part of the bay is located the town of Solin (19,000 inhabitants) lying in the area of the ancient town of Salona, while in the westernmost part of the study area the medieval town of Trogir (13,000 inhabitants) is located. Between these two towns, along the northern coast of the Bay, Kaštela are located (33,000 inhabitants), in the past seven separate villages, today developed in one unity. The total population of the area today amounts to about 257,000, which represents about 5.8% of the total population of Croatia, while the surface area represents less than 2% of the national territory, Table 1. The main feature of past demography is a continuing high increase between 1953 and 1981, when the population doubled. During that time the population growth rate was 2.31%. This growth rate was much higher than the national annual growth rate (0.59%). The higher annual growth rate was mostly the result of the local rural-to-urban migration, which was typical for the whole country, as well as the migration from other less developed areas.

Table 1: Population and population changes in the area

| | 1948 | 1953 | 1961 | 1971 | 1981 | 1991 | 2001 |
|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|
| Population (000s) | 114.6 | 127.8 | 151.9 | 203.5 | 255.7 | 284.8 | 257.0 |
| % population of Croatia | 3.03 | 3.25 | 3.65 | 4.6 | 5.56 | - | - |
| Annual growth rate (%) in area | 2.18 | 2.15 | 2.9 | 2.28 | 2.31 | 1.08 | - |
| Annual growth rate (%) in Croatia | 0.81 | 0.69 | 0.62 | 0.39 | 0.59 | - | - |

The fast population growth was accompanied by the development of tourism, industry, traffic and trade. The all industrial activity is concentrated at the north-eastern coast of the Bay, between the towns of Solin and Kaštela and on the north-eastern coast of the Split peninsula. The main industries are a shipyard, a brewery, food processing, and soft drinks production. The total employment in the industrial sector was 38.5000 workers. Tourism in the area is mostly of a summer-season character, despite the fact that the area is rich in ancient and mediaeval monuments. The principal tourist facilities are located in Trogir and Kaštela area, as well as in narrow coastal belt of Split. The registered capacity was 25,500 beds, and the total number of visitors was 386,000, which amounts to about 1,900,000 overnight stays (1989). The area represents an important traffic crossing point on the central Adriatic coast. The Split harbour is connected with the hinterland by railroads, as well as roads running along the coast, and to the hinterland. The passenger port is the single connecting point for the central-Adriatic islands with the mainland, as well as with other Adriatic towns of Croatia, Italy and Greece. The Split airport, located between the towns of Kaštela and Trogir, is open for domestic and international traffic. It is important for the transfer of foreign tourists. The coastal plain along the northern coast of the Kaštela Bay has always been important for the production of early fruits, while in the past 20 years a rather high green-house capacity for vegetable and flower production has been constructed in the western part of the area.

1.3. Main problems and conflicts

The analysis of the development processes showed that the past development of the area was based on the practice of exploiting the natural resources as being of unlimited capacity. The basic criterion of growth evaluation was the growth of separate development variables (population, income, production, etc.) instead of development in an integral sense (quality of life, environmental protection, protection of cultural heritage, etc.). Such development created numerous conflicts. There has been a disproportion between demographic and economic growth, between economy development and natural resources, between historical heritage and urban development, between separate activities and people of different cultures that moved from different areas. In less than four decades, this attractive and beautiful area with high tourism potential turned into an extremely degraded environment with highly polluted coastal sea, inadequate economic structure, inadequate urban infrastructure and numerous demographic and social problems.

The area of the Kaštela Bay is known as one of the most polluted areas of the eastern coast of the Adriatic. The environmental pollution is a consequence of fast industrialisation and urbanisation without development of appropriate urban infrastructure, in particular of a waste water collection and disposal system. The public sewers in each of the towns consist of numerous small subsystems; each of these consists of a gravity sewer collecting waste and rain waters, and a coastal outlet discharging the water into the coastal sea. They cover only a part of the town nucleus, and approximately 25% of the population is served by the sewerage system (in Split 60%). Buildings not served by the public sewerage systems have individual, mostly permeable septic tanks. Because of this, there are several large and more than several hundred small outlets into the area. Obviously, there is no waste water treatment in the area. Increased amounts of both urban and industrial waste waters are disposed untreated into the coastal sea resulting in numerous ecological problems and conflicts, as well as in the reduction of the quality of living. The main conflicts because of that are between industry and tourism, industry and housing, and waste water discharge and tourism.

1.4. Quantity and quality of waste water and sources of the sea pollution

The quantity of the urban and industrial waste waters of the whole area has been estimated at 49,000,000 m³/y (Margeta and Barić, 1996). About 60% of that quantity is discharged into the eastern part of the Kaštela Bay, while the remaining part is discharged into the Brač and Split Channels. The Kaštela Bay has been used as a recipient of the urban and industrial waste water since the late sixties when the town of Split expanded onto the Bay's watershed. Apart from direct and indirect discharges of the waste waters, the sea receives large quantities of wastes from various diffuse sources: (i) deposits from the atmosphere; (ii) runoff from urban areas; (iii) runoff from agricultural areas; (iv) runoff from the watershed area; (v) rivers, as shown for the Bay in Fig. 2. The yearly load of the Kaštela Bay by organic matter, expressed as BOD₅, suspended solids, and inorganic phosphorus and nitrogen is shown in Table 2 (Barić et al. 1996).

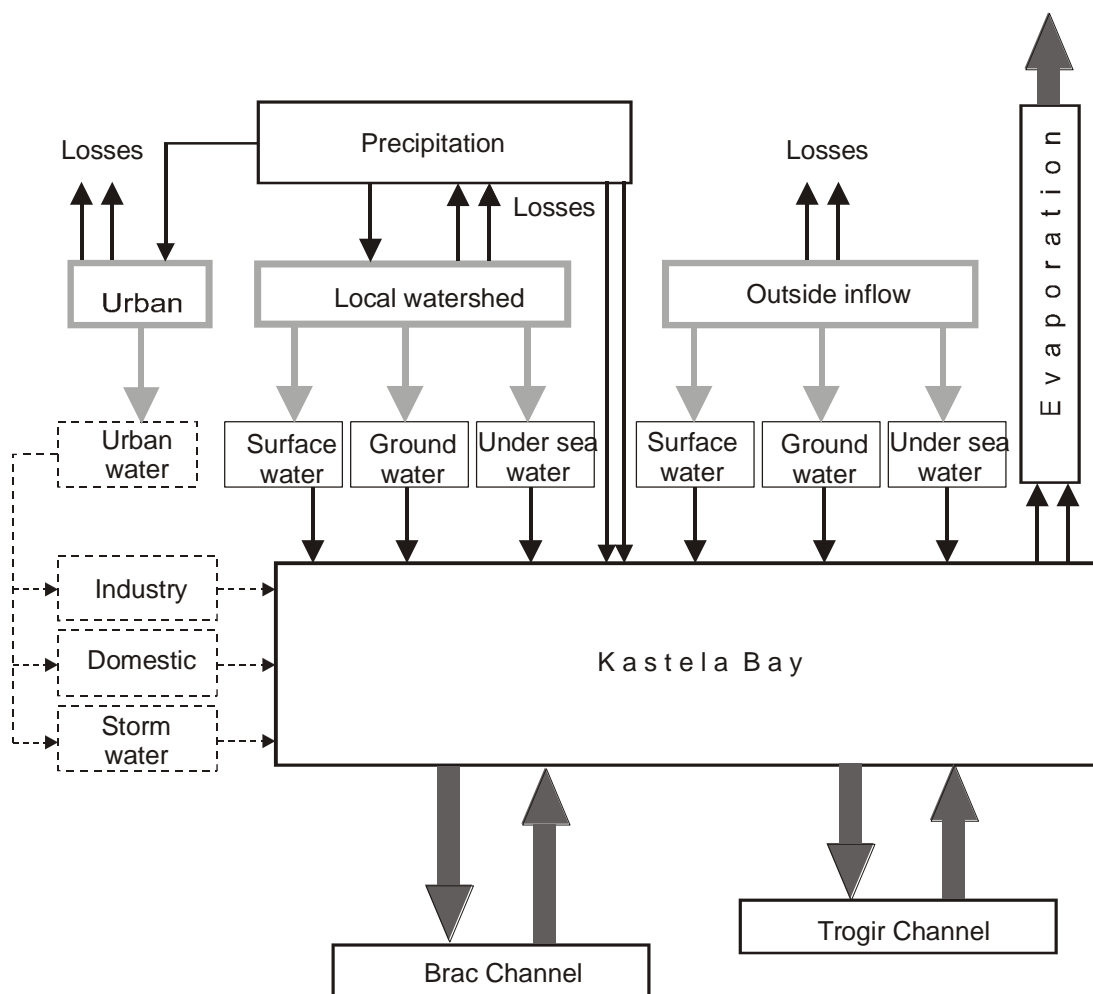


Figure 2. General hydrological scheme of the Kaštela Bay

As shown in Table 2, the largest portion of organic matter is discharged with domestic and industrial waste waters, while the largest portion of suspended solids arrives with storm waters and from the atmosphere. However, the highest contribution of inorganic nitrogen and phosphorus is from domestic waste water and rivers.

Table 2. Estimated load of the Kaštela Bay from different sources (Barić, et al. 1996)

| SOURCE | BOD 5 (t/y) | SUSPENDED SOLIDS (t/y) | P _{inorganic} (t/y) | N _{inorganic} (t/y) |
|------------------------|-------------|------------------------|------------------------------|------------------------------|
| Domestic waste water | 2,226 | 2,431 | 14.1 | 64.8 |
| Industrial waste water | 1,562 | 954 | 3.1 | 14.4 |
| Storm water | 984 | 4,920 | - | - |
| Air deposit | - | - | 1.2 | 9.6 |
| Underground water | 205 | 89 | - | - |
| Surface runoff | 27 | 87 | 6.1 | 16.0 |
| Rivers | 388 | 1,419 | 6.5 | 55.2 |
| TOTAL | 5,392 | 9,900 | 31.0 | 160.0 |

1.5. Characteristics of the sea

Two distinctive water bodies encompass the area of concern: the semi-enclosed Kaštela Bay and the Brač and Split Channels. Despite their interconnection, they represent different sea basins in terms of ecological characteristics and impacts from land-based sources.

The **Kaštela Bay** is the largest bay of the central coastal area of Croatia. The total area of the Bay is 61 km² and the average depth is 23 m, resulting in a total volume of 1.4 km³.

The Bay displays different bathymetric and morphometric properties, and two separate parts can be clearly distinguished: the deeper eastern and the shallower western ones. The Bay exchanges the water masses with the adjacent Brač Channel through the entrance between the Marjan peninsula and the island of Čiovo. The water renewal period of the entire Bay is about one month, while of its eastern part it is about 15 days. Vertical temperature distribution indicates the presence of a thermocline in the water column from April to October at a depth of 10-25 m. The annual mean salinity values in the surface and bottom layers are 34.43‰ and 37.27‰, respectively.

Based on the primary production, the Kaštela Bay is naturally a moderately productive basin. In the summer of 1980 the first "red tide", i. e. an extreme bloom of the dinoflagellate species, *Gonyaulax polyedra*, occurred in the Bay causing mass mortality of marine organisms in the eastern part due to reduced oxygen concentration in the water column. In the past years the "red tide" has become quite common, not only in the eastern part, but also practically throughout the Bay. This phenomenon is a consequence of domestic waste water discharge in the eastern part of the Bay. Eutrophication in the Kaštela Bay is significant (Barić et al. 1992). The concentration of dissolved oxygen has increased in the euphotic layer and decreased in the bottom layer. Long-term transparency monitoring confirms the increase of eutrophication in the Bay with strong negative impacts on the ecosystem. The Bay is contaminated by heavy metals, particularly mercury. However, the harvesting of shellfish from the Bay has been prohibited due to microbial contamination. Concentration of faecal indicators in the surface layer is higher than the permissible limits for bathing and recreational waters over almost the entire Bay (Krstulović and Šolić, 1991). As the consequence, the most attractive beaches of the area are not safe for recreational use, resulting in great losses for tourism.

The **Brač Channel** is narrowest, 5 km, along the central part of the island of Brač, and widest at the western end, 13 km. The greatest depth of 78 m is in the south-eastern part and 68 in the western part of the channel. The volumes of water masses of the Brač and Split Channels are 16 and 12 km³, respectively. The average time of water mass renewal has been estimated at 2.25 months (Margeta and Barić 1996). The hydrologic system of the Brač and Split Channels is complex and variable. The area of the Brač and Split Channels is relatively abundant in fresh water. Estimated average yearly fresh water inflow is 2,510.78 million m³. The largest source of fresh water is the Cetina river. Salinity ranges from 37‰ to 38‰. The temperature varies depending on the season, and ranges from 10 to 16.5°C at the bottom, and from 10 to 25°C at the surface. In the period from April to October a thermocline is formed at the depth of 10 to 20 m below a well mixed surface layer. The sea transparency ranges from 12 to 23 m. Concentrations of ammonia (annual ranges 0.14-3.10 mmol/m³), nitrates (annual ranges 0.00-1.80 mmol/m³), ortho-phosphates (annual ranges 0.000-0.156 mmol/m³) and ortho-silicate (0.14-6.88 mol/m³) in the Brač Channel are relatively low and show uniform distribution considering both the depth and the year seasons, indicating the oligotrophic condition of the channels in terms of nutrient concentrations (Barić et al., 1998). Oxygen saturation varies

seasonally in a narrow range: 95-110 % and 85-100 % in the surface and bottom layers, respectively (Barić et al., 1998). A long-term study of the phytoplankton in the Channels shows that the phytoplankton community is rather undisturbed without any sign of eutrophication. Microbial pollution is only recorded in the coastal area in the vicinity of the town of Split.

2. CAMP AND ASSOCIATED PROJECTS - APPROACHES APPLIED

Increased pressure of the affected population with initiatives of the scientific community as well as various sectorial initiatives of the local authorities, requesting for a comprehensive remedial program. The following were the major initiatives:

2.1. The 3rd Conference on the Protection of the Adriatic Sea, held in 1984, within its Declaration on the Protection of the Adriatic Sea, recommended, *inter alia*, the formulation and implementation of an environmental program for the Kaštela Bay area.

2.2. The PAP/RAC Pilot Project on the Kaštela Bay area (1987-1989).

The proposal for the formulation and implementation of the pilot project, within PAP action on Integrated Planning and Management of Coastal Zone, was submitted to the 1986 Meeting of the National Focal Points for PAP. After positive evaluation by the Meeting, MAP approved the proposal. Approvals for its implementation were also provided by the relevant national authorities. The implementation of the project started in 1987 and was completed in 1989, as part of the PAP Country Pilot Projects.

The project was implemented in co-operation with the University of Split, the Institute for Oceanography and Fisheries in Split, and with the Blue Plan/MAP and MEDPOL/MAP. The basic objective of the project was to assist national and local authorities in the process of mitigation and reduction of pollution in the project area, and rational use of its resources. The immediate objectives were:

1. the completion of the knowledge on: (i) the status of the environment in the bay area; (ii) causes of the deterioration, and (iii) major impacts and their significance;
2. introduction of the concept of integrated management, by applying the methodology of Integrated Coastal and Marine Areas Management, and introducing its most relevant tools, and
3. implementation of a number of studies related to selected most significant environmental and development problems.

After the start of the national project on Environmental Management of the Kaštela Bay, presented below, the two projects were harmonised, and the results of the PAP Project gradually introduced into and used by the National Project. The main individual activities implemented by the pilot project were related to:

- assessment of land-based sources of pollution in the area;
- target monitoring of the pollution of the Bay;
- study of natural characteristics of the Bay;
- criteria for discharge of waste water in the Bay;
- environment/development scenario;
- study of the red tide phenomena in the Bay;
- study on the mercury contents in marine environment and sea bottom;
- study on the development of aquaculture in the project area;
- study on the impact of wind on transport of sea masses in the Bay;

- preparation of EIA for a submarine outfall, and
- training on and application of GIS.

Among the major results of the project, the following might be emphasised:

- experience achieved in formulation and implementation of an integrated project related to environment/development interrelations in an area highly affected by uncontrolled development;
- involvement of local and national institutions and authorities in the project;
- involvement of a large number of local and national experts;
- data and information collected, and knowledge achieved on a number of critical issues;
- environment/development prospective elaborated.

After the decision of MAP to establish the MAP Coastal Areas Management Programme (MAP CAMP), the pilot project has been closed in 1989, to be reformulated and continued immediately within the MAP CAMP.

In parallel with MAP CAMP Kaštela Bay project two other projects were launched: (i) The OECD Study (1989-1990) and (ii) National project “Environmental Management of the Kaštela Bay” (1989-1992). The OECD Study implemented the study on “Integrated Environmental Management of the Kaštela Bay”. The study was prepared by the University of Split, under the guidance of OECD staff and with the assistance of PAP/RAC. The study analysed: (i) the natural systems and socio-economic conditions of the area; (ii) causes and consequences of pollution and environmental degradation; (iii) the demand for products and services from the project area.

Furthermore, the study presented the relevant legal and institutional framework related to: (i) pollution mitigation and control; (ii) land use and urban planning and (iii) the socio-economic planning and development. In its conclusive part, the study emphasised the need for the application of an integrated approach to planning and development activities. Finally, the study called for an economic restructuring, by applying clean technologies and introducing new economic activities, mainly the tertiary ones. The results of the study were used as input in the subsequent national project and the MAP CAMP “Kaštela Bay” project.

2.3. National project “Environmental Management of the Kaštela Bay”(1989-1992)

The most comprehensive study was National project “Environmental Management of the Kaštela Bay”. The project proposal was prepared by the Faculty of Civil Engineering, University of Split, and PAP/RAC. After the approval of the project by the local and national authorities, the financial support was secured from the EC in 1987 and from the WB in 1988. The implementation of the project started in 1989. The project was implemented by the University of Split in co-operation with the Croatian Academy of Arts and Sciences in Zagreb. PAP/RAC assisted the implementation of the project by: (i) providing relevant results of the PAP pilot project and of the MAP CAMP project, started in 1989 and described below; (ii) establishing contacts with UN agencies and other international institutions; (iii) presenting experience on application of integration, ICAM and relevant tools and techniques and; (iv) a modest financial support.

The general objectives of the project were, by application of scientific methods, to: (i) identify the causes of the present situation and trends; (ii) assess their impacts and significance, and (iii) development alternatives for sustainable development. Specific project objectives were as follows:

- to define the sensitivity, vulnerability and (limited) carrying capacity of the natural resources;
- to introduce standard procedures and parameters in the process of management of natural resources;
- to apply, within the project scientific framework, an integrated approach and principles of sustainable development.

The project was structured in three basic components: (i) Models and Modelling; (ii) Environment and Ecosystem; (iii) Socio-Economic-Spatial Systems; resulting in an integrated Synthesis. The major results of the individual project components were as follows:

Methods and Modelling: This sub-project was conceived and implemented so as to support the other two sub-projects. Methods were defined, related to the database, environment/development scenario, land-use (spatial) management, and valorisation of ecosystems by multicriterial analysis. A number of Decision Support Systems, of a sectorial or issue of specific nature were designed and applied.

Environment and Ecosystems: This sub-project was implemented through research modules related to soil, land, air, freshwater, and marine ecosystems. Each module was elaborated in detail, and the sectorial results integrated within the scenarios and development alternatives.

Socio-Economic-Spatial System: The sub-project focused on the state, dynamics and trends of development within the given environmental framework, elaborated by the second Sub project. A simulation model was developed and applied. Furthermore, applying the participatory principle, a survey on social and development aspirations was carried out among citizens, the results systematised, analysed and used. Finally, interrelations among the economic potential and the environmental capacity were studied.

The results of the first research cycle of the project were presented together with results of the MAP CAMP project in 1994. Unfortunately, despite a positive evaluation made by MAP/UNEP, by the relevant national and local authorities, and by the scientific community, due to the war and impossibility to obtain further international financial support, the second cycle of the project could not be formulated or implemented.

2.4. The MAP CAMP “Kaštela Bay” project (1989 - 1993)

In 1989 MAP approved the start of the MAP Coastal Area Management Programme (MAP CAMP) as one of four projects to be implemented in the first cycle the “Kaštela Bay” project. The structure of the project was based on the results and structures of the preceding PAP Pilot Project, respecting the needed continuity of activities, including additional activities and envisaging in-depth studies of some critical issues. This project was implemented by PAP/RAC, MEDPOL, and the BP/RAC, in co-operation with the Institute for Oceanography and Fisheries in Split, and the Faculty of Civil Engineering of the University of Split.

The objectives of this CAMP project were defined on the basis of the general objectives of the MAP CAMP, bearing in mind, at the same time, the features of the Kaštela Bay and the national project. Due to the almost parallel start of the national project presented above, the

contents and activities of the two projects were harmonised and synchronised, allowing the use of the results of the MAP CAMP project by the national project and vice versa, so results of the projects were combined in a unique one. Consequently, immediate objectives of the project were:

- (i) completion of knowledge on ecosystems, sources of non-compliance and relevant impacts;
- (ii) implementation of studies needed to define priorities, remedial measures and projects to be envisaged by such remedial programme;
- (iii) elaboration of some basic technical solutions.

Within the MAP CAMP project, the following major activities were implemented:

1. Preparation of a cadastre of pollution;
2. Programme of targeted monitoring of the Bay;
3. Study of oceanographic characteristics of the Brač and Split Channels;
4. Study of the optimum level of treatment of urban waste waters to be discharged into the Bay and the channels;
5. EIA of the Split-Stobreč submarine outfall;
6. Study on the impact of the climate change on coastal infrastructure;
7. Studies on fresh water resources of the western part of the Bay, and on the water supply for the islands of Drvenik Veli and Drvenik Mali;
8. Study of future solid waste disposal system;
9. Study on the rehabilitation of the Pantana area, an area of high environmental and cultural values;
10. Study on the pollution of agricultural soils in the project area;
11. Prospective study (environment - development scenario) for the area; and
12. Application of GIS for urban and land use planning.

In the program preparation and implementation the following was applied:

- a) general methodological approach of the MAP CAMP adapted to the specific features of this project and to the need to co-operate with National project,
- b) the specific method and approaches used in the implementation of other UNEP MAP activities, particularly:
 - methodology of the preparation of systematic prospective study adapted to the specific conditions of the project (Blue plan);
 - methodology EIA;
 - scientific basis and program of MEDPOL;
 - methodological approach to integrate coastal area management (ICAM);
 - UNEP-MAP approach to assessment of the impact of the expected climate changes;
 - for implementation of GIS activities: pcARC/INFO;
 - scientific methods and models applied to in various activities of the project.

It is worth mentioning that concept and programme of activities, although formulated much earlier, harmonized with Agenda 21. The major results of the project were related to:

- completion of data and information, and knowledge gained on major issues crucial for the formulation of a large remedial programme;
- technical solutions elaborated, related to the infrastructure, and remedial actions;
- basic information on the impacts of the expected climate change, indispensable in particular for the design of coastal infrastructure; and

- basic policy orientation elaborated by the prepared environmental development scenario.

The project results were presented jointly with the results of the national project, as described above. The major benefit from the MAP CAMP project were related to the use of its technical solutions as input for the subsequent design of infrastructure, implemented within the support of the WB METAP.

3. RESULTING CONCEPTS AND STRATEGIES

3.1. Resulting concepts

The studies and projects implemented in the 1986-93 period, in addition to their individual achievement, resulted in a well-funded understanding of concepts and strategies to be applied:

- a) the causes of deterioration of the socio-economic context and the state of the environment, the resulting impacts and their significance indicated the need for the adoption and gradual implementation of a comprehensive, long-term, multi-phase remedial and sustainable development programme, to be formulated according to the priorities and existing conditions for its implementation,
- b) the strategy of the programme to be based on an active development concept combined with appropriate remedial actions,
- c) the socio-economic studies and the environment/development scenario prepared indicated the need for a radical change in the hitherto development concept, implying change of strategy of national and coastal economy due to the new political context within the independent Republic of Croatia, and structural changes during the transition period, applying an integrated approach to coastal development, oriented towards Europe, the Mediterranean region and the world, based on market economy and principles of sustainable development,
- d) the conceptual approach to the programme should be based on the principles of: (i) sustainable development; (ii) integrated coastal and marine areas management and (iii) market economy, and
- e) as urgent priorities to be included in the long-term programme, the following activities were identified:
 - design and construction of the urban waste water collection, treatment and disposal system, according to the technical solution elaborated by the MAP CAMP project;
 - establishment of a sustainable system for solid waste management, including a new sanitary landfill;
 - recovery of the city port: prevent further discharge of waste water, monitoring and recovery of the port aquatorium, installation of port reception facilities, exploitation of port development potentials;
 - protection from pollution of the river Jadro, the major source of potable water for the area, by establishing an adequate development policy and monitoring over its entire catchment area;
 - monitoring, control and reduction of industrial pollution, generated in particular by the chemical, cement and metal industries;
 - upgrading of the water supply system in the western (predominantly tourist area) part of the area;

- rehabilitation and protection of the rich historic and cultural heritage, in particular of the Roman emperor Diocletian's palace and the Roman town of Salona, and their sustainable use (tourism, cultural and research activities);
- establishment and implementation of a continuous programme of scientifically based monitoring and research, oriented to sustainable development of the area and updating of the relevant knowledge and information.

3.2. Strategic approach to the protection of the Kaštela Bay and Brač and Split channels against pollution from land-based sources and activities

The protection of the coastal sea is one of the most important prerequisites of the sustainable development of the area, recognised by studies and by the local community. It includes integrated land-use management (soil, fresh waters, sea and air). As mentioned above, the main sources of the sea pollution are waste waters. Therefore the priority is given to the management of all kinds of waste waters. In order to achieve the long-term protection of the Kaštela Bay and the Brač and Split Channels from urban and industrial waste waters the following strategic approach was applied:

The Kaštela Bay is considered as an ecologically sensitive and socio-economically important area, and for its protection it is necessary to:

- eliminate from the Bay all outlets and outfalls discharging untreated and/or partially treated municipal waste water, as well as the leakage from permeable septic tanks;
- eliminate from the Bay all outlets discharging untreated and/or partially treated industrial waste water;
- establish a permanent monitoring programme of the coastal water.

The Brač and Split Channels, considered as less ecologically sensitive areas, are selected as the recipient of all urban and industrial waste waters of the area. The selection was done taking into account their relatively high volume and depth, intensive dynamics of water masses, and the present biological and ecological conditions which have not, so far, been affected by the waste water discharge. The waste water discharge should be done under the following general and specific conditions:

a) General conditions

1. Construction of appropriate municipal sewer system(s) for the collection, treatment and disposal of the entire amount of urban and industrial waste waters of the region.
2. Waste water disposal via long submarine outfalls ensuring appropriate initial and secondary dilution, and sanitary protection of a 300 m wide coastal sea belt.
3. Use of the natural capacities of the marine environment for wastes treatment, and application of a minimum level of urban waste water treatment. The final level of waste treatment should be determined on the basis of monitoring results. The applied level of waste treatment should ensure the avoidance of negative impacts.
4. Pre-treatment of industrial waste waters prior to their discharge into the municipal sewer system(s) in order to remove substances that can be detrimental to:
 - the operation of a biological treatment plant,
 - the usage of the sludge produced at the treatment plant,
 - marine ecosystems.
5. Elimination of all existing uncontrolled coastal outlets in the area.

b) Specific conditions

1. Studies for the siting and design of the submarine outfalls
2. Design and construction of sewerage systems
3. Efficient management and maintenance of sewerage systems
4. Public participation
5. Monitoring and information
6. Computer-based Decision Support System for Coastal Water Resources Management

The following long-term targets should be achieved by the fulfilment of the above listed conditions:

Sanitary quality of the coastal sea: The coastal sea belt, 300 m wide in the entire area, should be sanitary clean and safe for bathing and recreation in all weather conditions. It means that in many locations in the coastal area the sanitary quality of the sea should be improved.

Aesthetic value of the sea water: The aesthetic value of the sea water in the coastal belt should be unaffected by the discharged waste waters which implies the improving of water quality in most locations, which are presently under the impact of small outlets. Only a slight increase of turbidity may be expected in a wider zone of the channels nearby the diffuser(s) location.

Benthic communities: Damaged benthic communities in the coastal region should be recovered, particularly in the entire Kaštela Bay, but communities in the vicinities of submarine diffusers will be completely destroyed.

Eutrophication: The discharge of urban waste would increase the eutrophication in the Channels, resulting in the increase of primary productivity and phytoplankton biomass, and slight changes in the structure of phytoplankton community, but the “red tide”, oxygen depletion in the bottom layer (except in the vicinity of diffuser) and other accompanying phenomena should be avoided. At the same time, a gradual improvement is expected in the Bay.

4. IMPLEMENTATION

4.1. The integrated infrastructure project

Already the initial results of the CAMP “Kaštela Bay” and other relevant projects confirmed the need to build the basic urban infrastructure necessary for a sustainable development of the wider area of the Kaštela Bay. Accordingly, in the year 1989 a number of local institutions, headed by the Faculty of Civil Engineering of the University of Split and in co-operation with the Enterprise of Construction of Split proposed a programme of construction of urban infrastructure entitled “**Integrated Ecological Project Split-Solin-Kaštela-Trogir: Infrastructure Programme**”. Through the construction of urban infrastructure the following objectives were planned to be achieved: (i) clean sea, (ii) clean air, (iii) healthy drinking water, (iv) land free of all kinds of waste. A programme of implementation of the project was agreed with representatives of the World Bank within the WB METAP – Kaštela Bay.

The infrastructure construction programme referred to:

- waste waters, both urban and industrial;

- solid waste, both urban and industrial;
- bilge;
- waste oils.

It was expected that these problems would be resolved in a period of 5-8 years, starting from 1990. It was expected that the implementation of the project would contribute to considerable reduction of sea pollution. The initial phase envisaged the preparation of programmes at the level of feasibility studies for the following projects:

- sewerage systems for the towns of Split, Solin, Kaštela and Trogir;
- collection, treatment and disposal of urban and industrial solid wastes of the towns of Split, Solin, Kaštela, Trogir, Omiš and Sinj;
- water supply for the towns of Split, Solin, Kaštela and Trogir;
- protection of the water resources of the watersheds of the Kaštela Bay, Brač Channel and river Cetina;
- air pollution of the towns of Split, Solin, Kaštela and Trogir;
- traffic and traffic lines of the towns of Split, Solin, Kaštela, Trogir and Omiš;
- architectural heritage of the towns of Split, Solin, Kaštela and Trogir.

A detailed programme was prepared for each of the projects, containing: goals and objectives, activities and their contents, implementation phases, expected results, analysis of the degree of completion of the project, implementation dynamics, costs of preparation, investment and exploitation, and proposal of financial sources.

The funds necessary for the implementation of the projects were thoroughly analyzed and assessed, as well as the possible sources of financing. It was proposed that the projects be financed from several sources: local funds, local urban services, the state, donations and bank loans, and primarily the World Bank. The analysis also included the ways how the loans would be paid off and how the funds would be secured for the operation and maintenance of the built systems. Those primarily referred to the price of services (water, sewerage, waste), and urban rent.

Within the elaboration of the infrastructure construction programme an analysis was made of the necessary organizational arrangement to implement such a comprehensive programme in an area covering several administrative units. Concentration of almost all urban problems in one integrated project requires a suitable organisational model for the project implementation. Accordingly, two models were proposed: one was based on the existing institutions, and one envisaging the establishment of a new institutions. The second alternative was eventually adopted, and it was proposed that a special centre be established for the implementation of the Integrated Ecological Project. The proposed programme and projects were verified at all levels, the rights and liabilities of all involved parties were agreed upon, and the programme implementation was launched in 1989. Funds were secured for the preparation of studies and projects, mostly from the local sources, but there was also a considerable amount donated by the World Bank through the METAP – Kaštela Bay.

In the period 1989-1990 most of the studies and projects were prepared and the prerequisites were provided for the construction of the planned infrastructure. In October 1990, a World Bank mission was organised to the area, headed by Mr. Richard McEwan. During their visit, tentative costs of each project were agreed upon, as well as the possible total amount of the loan (US\$ 108 million). The mission also defined a programme of further activities necessary

to realize the loan and the project as a whole, and especially the preliminary actions to be performed, and conditions to be met by the local urban services and the towns, i.e. the beneficiaries of the loan. Unfortunately, the hostilities that broke out in 1991 and lasted until 1993, interrupted the collaboration with the World Bank on the implementation of this project. However, the programme of preparatory activities for the implementation of the project went on as planned, throughout the hostilities, although with a certain delay. In that period the entire project documentation was completed and most of the preparatory administrative measures necessary for the project implementation were taken (changes of town plans, obtaining permits, etc.). In that period, a new institution, “ECO-Kaštela Bay”, was established with the objective to implement the Integrated Ecological Project – Infrastructure Programme.

4.2. Follow up

In the year 1994, contacts were renewed with the World Bank, Washington, and in collaboration with them, with the European Bank for Reconstruction and Development, London. In the period 1996-1997, loans were agreed for two projects:

- Project No. 1: Sewerage systems Spli/Solin and Kaštela/Trogir (Figure 3);
- Project No. 2: Water supply system.

Tentative agreement was reached on the implementation of other projects in the future. The long-term solution of the sewerage system, developed on the basis of a detailed analysis of ecological, technical and economic parameters (in CAMP and other related studies), envisages the construction of two separate sewerage systems, one for the Split – Solin area (Margeta 1990) and a separate one for the Kaštela – Trogir area (Margeta, 1992) (Fig. 3). Each system is of a separate sewerage type, consisting of a sewerage network, collectors and pump stations, a central waste water treatment plant, and a corresponding submarine outfall. The Split and Solin waste waters would be treated at the central plant of “Stupe” and discharged into the Brač Channel in front of the town of Stobreč. Waste waters of the Kaštela and Trogir area would be collected and treated at the treatment plant located in the central-southern part of the island of Čiovo and discharged into the Split Channel in the front of the village of Mavarščica. The development of each sewerage system has been planned so as to be executed in several phases. The first phase of both systems consists of the construction of a primary waste treatment plant and main collectors together with accompanying pump stations. The second and further phases envisage the construction of secondary sewers and connectors, and, if necessary, based on the results of the monitoring programme, the secondary or higher-level waste water treatment. The gradual approach to implementation would enable optimal sea protection considering the negative impacts and economic potential of the region. The planned step-by-step construction of the waste water treatment plant and the submarine outfall enable a simple adaptation to future needs and requirements in order to comply with the increase of waste water quantity, as well as sustainable development criteria.

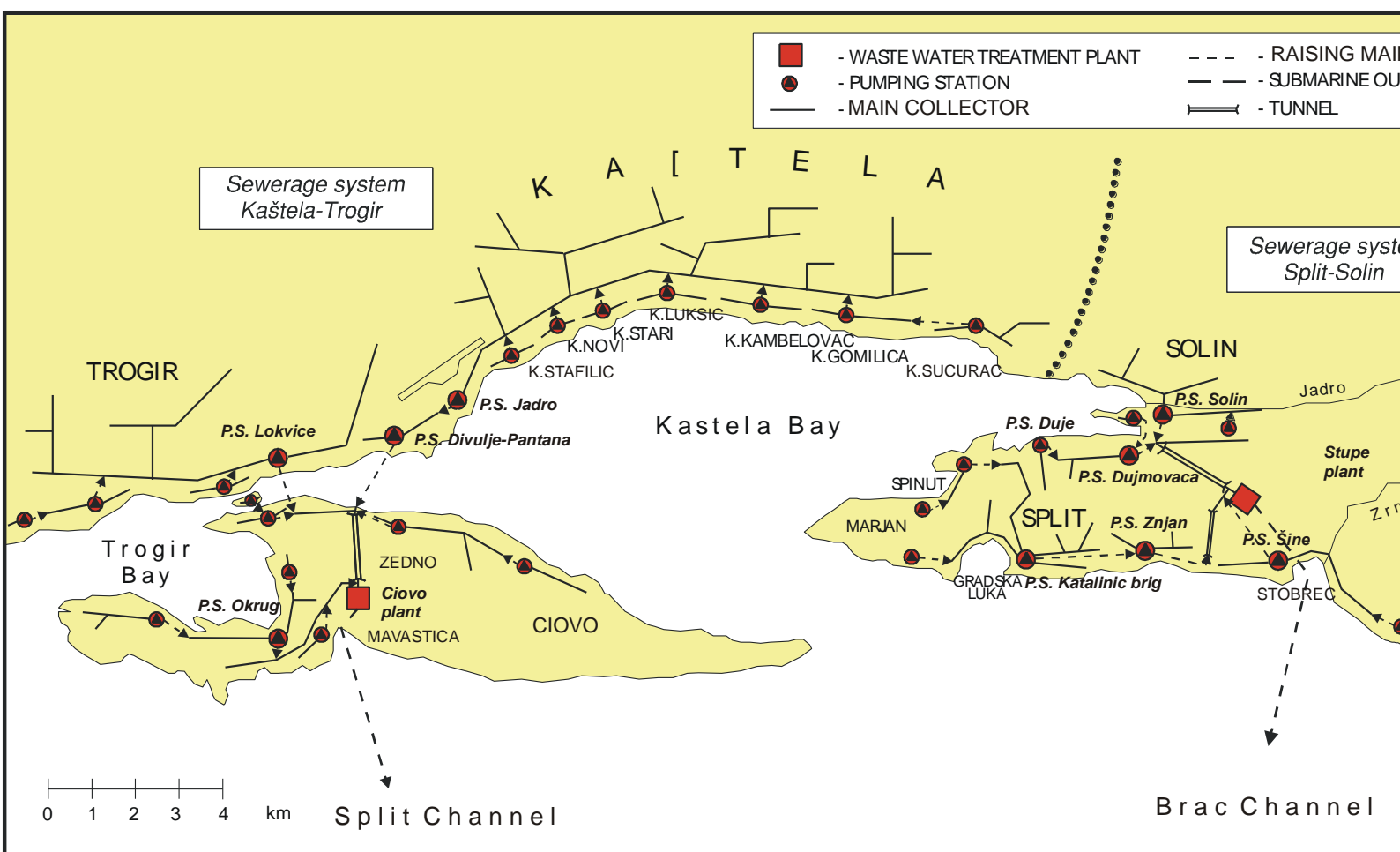


Figure. 3. Concept of a long-term solution of the sewerage system in the Kaštela Bay area.

The first project envisages the construction of the 1st phase of the two sewerage systems which includes the sewerage network approximately 60 km long, 7 large and 11 smaller pumping stations, two hydro-technical tunnels long 2.4 km and 1.8 km respectively, two treatment plants and the belonging long submarine outfalls, as well as the appropriate management system. The second project envisages additions to and spreading of the existing water supply system which includes the construction of a central pumping station, four smaller regional pumping stations, 17.5 km of water supply pipelines, and four reservoirs of various capacities, as well as an appropriate management system. The total cost of the investment was estimated at US\$ 130 million.

According to the conditions posed by the banks, a procedure was launched to select the author of the project and tender documentation. The international competition was closed in 1998, and the preparation of the project and tender documentation for both projects was contracted, and is currently in course. The selection was also made of potential contractors for various works. The construction started in autumn 1999.

The only problem encountered so far in the implementation of the Kaštela/Trogir sewerage system regards a delay in the preparation of the project documentation due to local problems relative to the location of the treatment plant. At present, alternative solutions of this sewerage system are being studied. The other projects are being implemented according to the plan. Alongside these projects, another one is being implemented. It is the project of collection, treatment and disposal of solid waste. The project is implemented outside the "ECO-Kaštela

Bay” agency and is under direct control of the town of Split and its institutions. The optimum, temporary solution for the solid waste treatment and disposal has been selected, and the implementation of this project is in course. At the same time, works are continued on a long-term solution for the wider region.

At present, negotiations are in course with the World Bank on the activation of other, earlier agreed project. This primarily refresh to the revitalization project for the Diocletian’s Pallace in Split which is at the UNESCO’s list. The first phase of the Pallace revitalization is completed, and all works were financed by the town of Split.

Traffic problems are also being gradually revolved within the institutions of the Republic of Croatia. The problems of air pollution are also tackled through the process of industrial restructuring and privatization. This problem, owing to the consequences of war and decreased industrial activity, isn’t so pronounced any more.

A part of the activities aimed at the revitalization of the town harbour have also been implemented. A sewerage ring around the harbour has been constructed so that the waste waters are no longer discharged into the harbour, but are being pumped into the submarine outfall in the Brač Channel.

4.3. Agency “ECO - KAŠTELA BAY”

The implementation of the Integrated Ecological Project was entrusted to the “ECO-Kaštela Bay” agency located in Split. The founders of the agency are the towns/municipalities in the area to be covered by the infrastructure project, namely Split, Solin, Kaštela and Trogir, as well as the Government of Croatia through the relevant ministries/institutions. The main task of the Agency is, on behalf of its founders, to prepare and implement the agreed projects of common interest. The Agency represents its founders in front of investors and banks, and implements the project according to the conditions posed by the creditors and the founders.

In order to implement the mentioned adopted conceptual solution for the management of waste waters in the area, a project under the title ECO KAŠTELA BAY has been developed. The project envisages the construction of the main elements of the sewerage systems in order to divert the waste water from the Kaštela Bay into the Brač and Split Channels. In the western part of the area, the system includes a main collector with accompanying pumps along the northern coast of the Kaštela Bay, a treatment plant, a tunnel through the Čiovo island, and a submarine outfall in the Split Channel. In the eastern part of the area (towns of Solin and Split) the system consists of a main collector with accompanying pumps in the eastern part of the Kaštela Bay, a hydrotechnical tunnel, a treatment plant, and a submarine outfall in the Brač Channel. The realisation of the sewerage systems would be the first step towards the protection of the Kaštela Bay.

These selected structures ensure that each sewerage system can function as a separate and complete technological system which ensures environmental protection and high standards for the users of these systems. This system also ensures the use of the coastal sea in accordance with the legislation and development plans.

The project has a number of components, each of which will produce some favourable environmental effects. Those are:

- Waste water treatment plant of “Stupe” and the belonging submarine outfall: It is certain that this will be the component to have the greatest merit in preventing further pollution of

the Kaštela Bay, as well as in eliminating the pollution of the coastal strip of the town of Split. All the waste water of the towns of Split and Solin, hitherto discharged into the Kaštela Bay, will now be treated and discharged into the Brač Channel through a long submarine outfall.

- Split-Solin sewerage system extension and improvements: The work on the extension and improvement of the Split-Solin sewerage system will include the interception of all waste waters now discharged into the Kaštela Bay from this area, and their collection in the “Stupe” waste water treatment plant, which will prevent further pollution of the Bay. Also, the waste waters from the port of Split, hitherto discharged locally into the Brač Channel, will be intercepted and collected at the “Stupe” plant.
- Waste water treatment plant “Čiovo-Divulje” and the belonging submarine outfall: This component will contribute greatly to the prevention of further local pollution of the Kaštela Bay from the Kaštela area, as well as of the Trogir Bay from the Trogir area. All the waste waters of the towns of Kaštela and Trogir, hitherto discharged into the Kaštela and Trogir Bays, will now be treated and discharged into the Split Channel through a long submarine outfall.
- Kaštela-Trogir sewerage system extension and improvements: The work on the extension and improvement of the Kaštela-Trogir sewerage system will include the interception of all waste waters now discharged into the Kaštela Bay and Trogir Bay from these areas, and their collection at the “Čiovo-Divulje” waste water treatment plant, which will prevent further pollution of the Bays.

In addition to the waste water management, the project contains another component dealing with the freshwater supply of the western part of the area. It plays a double role. Besides the improvement of freshwater supply in the western part of the area, lacking fresh water, particularly in the summer season, it will enable further economic activity, as well as increase the water consumption, ensuring the necessary funds for the pay back of international loans. Namely, the pay back money is generated from the 25% higher price of tap water.

5. LESSONS LEARNED

Among the specific results of the project, it should be mentioned that the project implementation and its results confirmed in practice the need for and benefits from the application of a scientific approach, application of the methodology and tools of integrated coastal management, and of the principles of sustainable development, when dealing with complex environment/development problems, in this case of the Kaštela Bay area. The project widely contributed to the rising of awareness of the general public and authorities regarding the state of the environment and the need for sustainable development.

The good results of this project with regard to the sea protection against waste waters were possible to achieve owing to the fact that along with the preparation of this project, the preparation was in course of a feasibility study of the waste water systems of Split, Solin, Kaštela and Trogir (Faculty of Civil Engineering). This situation enabled that the studies prepared within the CAMP project have/use good and reliable information regarding the goals and needs of the sewerage system development in accordance with technical and legal requirements/constraints. That way all CAMP studies were directly usable for the designer of the sewerage system feasibility studies, or better said, they are part of the feasibility study of the sewerage system. This symbiosis of projects turned out to be very useful which resulted in a good quality solution of the sewerage systems. Namely, the WB experts have fully accepted

the proposed solutions which, in turn, resulted in a fast approval of funds to finance these sewerage systems by the WB, and the construction is presently in course.

The most important factor which contributed to the success of the CAMP project was the fact that the project was guided and formulated according to the engineering requirements for the solution of the identified problems of solid and liquid wastes disposal. The requirements were defined by engineers, while the scientists involved in the CAMP project collaborated with the engineers when searching solutions for important issues and topics, which contributed to the high quality of the solutions which were scientifically elaborated and defined, and applicable from the engineering point of view.

The down side of the CAMP “Kaštela Bay” was a large number of various activities which did not represent a whole, nor did they produce a single result-product. Perhaps it is a peculiarity of the CAMP “Kaštela Bay”, since the activities of this project covered the gaps in the engineering projects implemented simultaneously contributing thus greatly to the success of those parallel projects. Therefore, the CAMP as whole does not have a single comprehensive result, but rather a series of results from a number of various fields. Unfortunately, such work did not enable all the participant to understand the final objectives of the project, so the activities and results remained somewhat unharmonised.

6. SUGGESTIONS FOR CAMP FORMULATIONS

A CAMP project should be planned carefully by a top-down and down-top procedure. Goals and objectives has to be planed by to-down procedure while activities necessary to accomplish these goals and objectives by down-top procedures. It is not good that a CAMP represents a set of individual and unharmonised desires of the host country in accordance with local interests. It is not good that CAMP tackles a large number of various problems which do not make logical whole, either territorially or functionally. The role of CAMP must not be generic, such as capacity building, data collection, GIS application, and similar. In order for a CAMP project to have a good and useful result it is important to know what will be the one comprehensive final project result, while capacity building, GIS application and the like, are just accompanying activities and not the final and most important goals of the project. They are in reality useless if not strictly linked with the final result of the project.

With regard to the planned result/product of the project it is necessary to plan the required activities that make part of a whole that will lead to the achievement of the set goals. Most important of all is that the goal/product is understandable, measurable and easily recognizable so that all the participants in the various activities can know from the outset what will be the final and most important result of their work.

In order to achieve good results this five most important prerequisites have to be met:

- (i) A group of local and international experts has to formulate the overall project as a coherent whole and product. At that some activities may be implemented both within the project and outside it, while some have been completed with CAMP using their results. The final result is a product provided by the CAMP regardless of who and where implemented the activities that led to it.

- (ii) One local and one international expert with good references in the relevant discipline, who also made part of the group which formulated the overall project, have to lead, coordinate and be responsible for the scientific implementation of the project. It will be mostly their responsibility that the planned goal/product is achieved in time.
- (iii) Scientific co-ordination must be strictly separated from the administrative co-ordination of the CAMP project.
- (iv) Financial means must always be adequate to the expected result. A CAMP project must not be implemented as a social project for local experts.
- (v) The result/product of the CAMP project must be concrete, of immediate importance, and useful/applicable for the region or the local community.

Finally, I don't think that a CAMP project must always be an area development or land-use project. It would be more useful if a CAMP Project were a problem-oriented project related to a single resource management (land, water, protected area, ...).

7. SUMMERY AND RECOMMENDATIONS

Due to a number of political, historical, natural and socio-economic reasons, the area of the Kastela Bay near the city of Split in Croatia, in mid eighties, became one of the largest and most widely known pollution "hot spot" areas in the Mediterranean region. In less than four decades, the area turned from a pristine area of high tourist potential into an area with highly degraded natural ecosystems, particularly its coastal waters, inadequate economic structure, as well as a number of demographic and social problems. All these have prompted the relevant authorities to start the activities aimed at the improvement of the situation in the Bay.

In order to asses the actual state, its causes and possible solutions to the problems, a number of studies have been prepared, the most important of which are the CAMP "Kastela Bay" and the national project on natural resources management. The World Bank's METAP project was associated with the above programmes some time after initiation. Lately, as a result of the above studies and other activities, an integrated ecological project for the infrastructure development was launched. All of these projects have created a necessary basis for the most concrete action to follow. Unfortunately, due to the war in Croatia, the activities on the projects implementation were postponed for some time.

After the war, the activities on infrastructure development have been clearly indicated as the first area for the projects implementation. The Croatian Government, as well as the local governments of the Bay's surrounding municipalities have given the approval for the action to be taken with development banks. The WB and EBRD have approved large loans for the construction of sewage systems. Other actions and financing indicated in initial program are to follow.

This program is one of rare examples in the Mediterranean where modest initial activities (CAMP) have evolved into a concrete implementation and activity on the improvement of the environmental systems. As such, it could provide valuable information on how this approach could be replicated in Croatia and elsewhere in the region.

The CAMP “Kaštela Bay” project proved very useful for the local community in resolving the crucial problems relevant to waste disposal. Through the local and international experts its engaged, the CAMP project provided the necessary assurance and gave good directions for the activity of the national institutions and local organizations, and especially to the politicians and the local population, prompting them to start resolving the growing ecological and economic problems. From that point of view, the role of the CAMP project was irreplaceable and immeasurable. Such role of CAMP is highly useful, so the CAMP activities should be developed with this goal in mind.

Based on the MAP i PAP experience, the following recommendations were made for the CAMP “Kaštela Bay”:

- a) Carry on with the project of sustainable management of the Kaštela Bay area and the county of Split-Dalmatia.
- b) Consider the appropriateness of and need to formulate a wider management project that could have three parts: (i) the coastal area of Croatia, (ii) the continental part, and (iii) integration of all areas of Croatia, both coastal and continental.
- c) Immediately start the formulation and preparation of a study on interrelations between the management mechanism and coastal area management processes.
- d) Start the preparation of a programme of international financing based on the results and recommendations of MAP reports and the national project reports.

All these proposals are still very actual and fully in accordance with EU policy on coastal - land - watershed integrated management.

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