Coastline planning and management through digital mapping systems

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Abstract. Albania is a country with a coastline of 316 km. The potentiality offered turns into a determinant factor for the Albanian economy. However specific issues need a solution. One of them remains the shoreline pollution. It affects mostly foreign visitors, also local population which recently tends to avoid attending these areas, instead they frequent foreign places. The importance of GIS technology in the water sector is undisputed. This paper will present a full set of digital maps representing a complete picture of the Albanian shoreline situation. The entire coastline is divided into the major frequented areas with a spatial extension based mainly on district level.

1. Introduction
Many coastal ecosystems still remain adversely affected by current land-use practices and the ever-growing demand for coastal lands from urbanization. And unfortunately, the recent economic recession is expected to provide only temporary respite in the trend of coastal land take [1]. In both developed and developing countries, the coastal zone is likely to undergo the most profound change in the near future [2]. As already known the two primary factors for coastline change remains natural process and human intervention. Natural factors remain great forces that are hard to manage, while human processes belong to the classified category which can be totally controlled and well managed.

The study involves measures on 70 check point over the Albanian coastline [3] with the aim of identifying problematic zones with high percentage of pollution values. The results reveal 36 problematic areas with high risk of bacteria, translated in other words half of the coastline is unsuitable to be frequented by tourists or native population.

The main reason that induces the verified situation is the uncontrolled urbanization phenomenon near these areas followed by unplanned investments, eager to benefit at the expense of coastal space leading to the degradation of natural resources which will close development options.

It is generally expected that Remote Sensing and GIS techniques and instruments will be of increasing importance in coastline and coastal zone management [4]. Through GIS technologies we intend to estimate the coastline situation creating a full picture overview of the current condition. This knowledge will enable coastal planners, inhabitants and decision makers to better understand and evaluate the current situation with the goal of improving the list of necessary steps to be undertaken producing a result to the benefit of the Albanian coastline.

2. Materials and methods
Coliform bacteria have been used to evaluate the general quality of water. Two other groups of bacteria that are present in feces are: fecal streptococci (FS) and Clostridium (FC) [5]. Our
investigation consists by taking in consideration the values obtained by the Public Health Institute which has set a limit rate of 100. The paper reveals the current situation of the whole Albanian coastline. A set of digital maps have been structured cutting the coastline into specific areas according to the most visited beaches and their geographical position. Small beaches lying on close spatial areas have been grouped for study reason. As source map we have used the digital map of Albania under the GCS_WGS_1984 projection will a scale of 1:400.000.

The research goal is to define the most polluted areas and their risk factor. The results will show us the problematic of the studied area expressed through digital maps. From a visual impact the population awareness could increase and the responsible authorities’ management process could improve.

As we notice from the digital maps (figure 1, figure 2) the northern coast which covers two primary beaches Velipoja and Shëngjin generally is considered an acceptable area to be frequented by the population. From the 12 measured check points only Shëngjin beach contain a critical area that exceeds the allowed limit (table 1, 2).

Figure 1. Albania Coastal Pollution, Study zone: Velipojë, Software: Package ArcGIS, ArcMap 10.
Source: Ministry of Environment, Forestry and Water Administration.

Table 1.

| Ch. P. | 1  | 2  | 3  | 4  | 5  | 6  | 7  | Average | Norma/100 ml |
|-------|----|----|----|----|----|----|----|---------|--------------|
| FC-50 | 40 | 35 | 33 | 29 | 48 | 34 | 33 | 36      | 100          |
| FS-50 | 23 | 24 | 20 | 14 | 27 | 22 | 20 | 21      | 100          |

If we continue geographically down the territory basically in the central zone of the Albanian coastline we face a problematic situation. The values generated induce us in categorizing Durrës and many parts of Kavaja beach among the dangerous areas to be strictly avoided in any period of the year. As we can obviously see from the map and the relevant table (figure 3), most of the values not only exceed the defined normative but boost by multiple times the limit of 100. All the 21 check points that belong to Durrës beach are considered inappropriate to be visited (table 3). As for Kavaja shoreline the situation seems to be more optimistic in half of the coast but still the other half needs urgent intervention (table 4). According to these values we can rank these two beaches as the most polluted areas in the whole Albanian coastline.
Figure 2. Albania Coastal Pollution, Study zone: Shëngjin, Software: Package ArcGIS, ArcMap 10
Source: Ministry of Environment, Forestry and Water Administration.

Table 2.

| Ch. P. | 8  | 9  | 10 | 11 | 12 | Average | Norma/100 ml |
|--------|----|----|----|----|----|---------|--------------|
| FC-50  | 45 | 87 | 20 | 19 | 36 | 41      | 100          |
| FS-50  | 85 | 128| 56 | 83 | 46 | 80      | 100          |

Moving into the south the situation seems to change gradually. Vlora beach faces areas that are adaptable to be frequented with parameters below the allowed normative (figure 4). From 11 check points, 7 of them seem to have good quality water (table 5). Still if we notice carefully there is especially one zone that exceeds the limit by 15 times and three more by 3 or 4 times.

Not by chance Dhërmi, Himarë and Borsh are the most frequented beaches during summer and in general. According to the map and the corresponding values (figure 5) the average of the measuring parameters (table 6), FC = 9.8 and FS = 7.5, ranks them among the most required places by native and especially foreign tourists. They remain the referring point for a nice and pleasant vacation period.

The southern beach of Saranda closes the Albanian coastline. Based on the map (figure 6) and the relevant table of measured check points (table 7) we conclude that the situation doesn’t seem to improve joining the pessimistic overview created by the overall panorama of the whole country shoreline.

Regardless of the influencing factors, whether natural or human, tougher policy must be followed. Local governments must collect and maintain updated sets of digital maps concerning coastline issues. In addition, a GIS approach to coastal management provides a process to bring together groups that cut across professional disciplines to work together toward a common goal and more effectively communicate information about coastal management issues to decision-makers [6].

The mapping of the coastline situation is a mandatory input of vital importance for further decision-making progress [7]. We insist in leading further digital mapping projects to investigate environmental issues for the benefit of population welfare. The application of GIS and remote sensing techniques to monitor coastline change should be carried out jointly with routine observatory work in order to improve our understanding of the environmental problematic [8].
Table 3.

| Ch. P | FC 50 | FS 50 |
|-------|-------|-------|
| 1     | 1073  | 669   |
| 2     | 906   | 687   |
| 3     | 679   | 435   |
| 4     | 640   | 591   |
| 5     | 455   | 424   |
| 6     | 281   | 206   |
| 7     | 247   | 194   |
| 8     | 199   | 161   |
| 9     | 186   | 142   |
| 10    | 171   | 135   |
| 11    | 162   | 124   |
| 12    | 162   | 107   |
| 13    | 154   | 118   |
| 14    | 151   | 104   |
| 15    | 142   | 118   |
| 16    | 140   | 93    |
| 17    | 130   | 95    |
| 18    | 121   | 92    |
| 19    | 118   | 88    |
| 20    | 115   | 72    |
| 21    | 114   | 81    |
| Average | 271  | 228   |

| Norma 100 ml | 100 | 100 |

Figure 3. Albania Coastal Pollution, Study zone: Durrës, Kavajë
Source: Ministry of Environment, Forestry and Water Administration.

Figure 4. Albania Coastal Pollution, Study zone: Vlorë; Software: Package ArcGIS, ArcMap 10; Source: Ministry of Environment, Forestry and Water Administration.
3. Conclusions
The coastline issue in Albania remains a problematic topic due to its particular importance in the
economical and management sector. Due to remote sensing we can easily gain access to spatial data which integrated into the proper software can produce important outcome for the benefit of coastline planners and decision-makers.

Figure 6. Albania Coastal Pollution, Study zone: Sarandë; Software: Package ArcGIS, ArcMap 10; Source: Ministry of Environment, Forestry and Water Administration.

The current shoreline situation seems to be pessimistic leading to the importance of urgent intervention from responsible authorities. We induce in exploiting maximally digital mapping as the right solution for issues that are spatially connected.

Analyzing data from a visual perspective turns to be more productive than just rough data. Digital maps show us that half of the coastline suffers from high level of pollution which makes them inappropriate for any kind of exploitation. The other half still need correction in many areas which are considered somewhat appropriate. If some of them are still under pollution limits, it does not come because of their careful management, but simply because of non massive frequentation [9].

The paper outline the importance of data management where digital maps tend to induce both categories, coastline exploiters including native inhabitants and tourist, also responsible entities including local authorities and government institutions and organizations.

References
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