

Ranking of the coastal areas of Cyprus regarding their vulnerability in pollution episodes using GIS and multiple-criteria analysis

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Abstract

Coastal zone is a diverse and sensitive ecosystem, hosting a variety of human activities worldwide

Impact assessment of human activities on the quality of coastal environment is necessary

GIS and multi-criteria analysis were used to evaluate and rank the coastal areas of Cyprus, regarding their vulnerability to possible pollution incidents

Regime Method

Valuable tool in decision-making process to support establishment of a coastal management plan

Environmental impact to pollution incidents

Economic impact to pollution incidents

Introduction

- Coastal zone is considered an area with unique morphological characteristics and a complex ecosystem assembling numerous human activities¹
- It is the interface of the 3 fundamental elements of nature: land, water and air²
- 40-50% of world's population is concentrated 100km from the coast³
- The aim of the present study is to assess the sensitivity of cypriot coastline in terms of their vulnerability to potential pollution incidents, using an integration of GIS and multi-criteria analysis
- Two scenarios on the environmental and economical impact, were considered.
- The proposed methodology is widely applicable and could support decision-making for the prevention of coastal degradation.

Materials and Methods

Sensitivity analysis

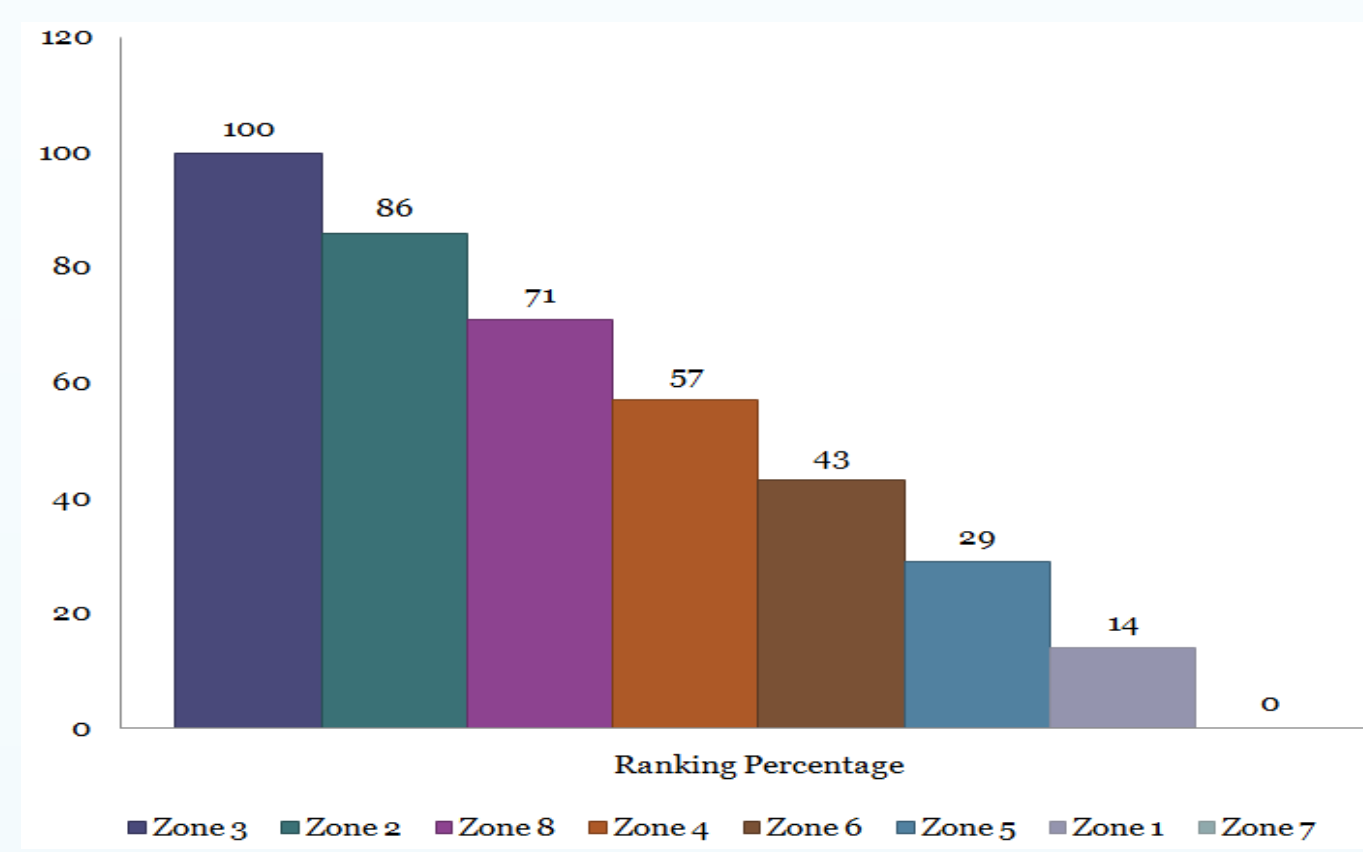
Application of multiple-criteria analysis based on appropriate evaluation criteria relevant to characteristics of cypriot coastal zone

Zoning of cypriot coastline

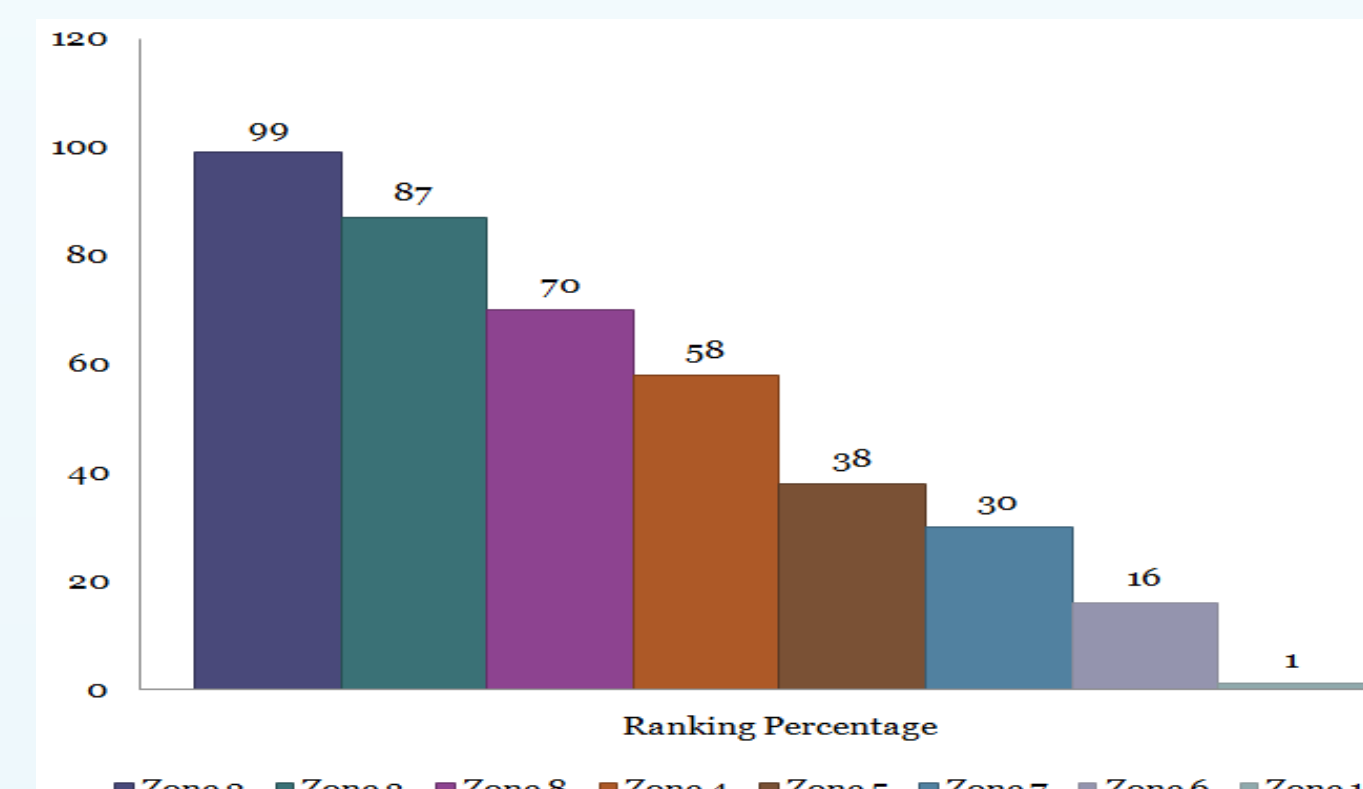
Data processing and spatial analysis methods using Geographical Information Systems (GIS)

Data collection and design of geodatabase

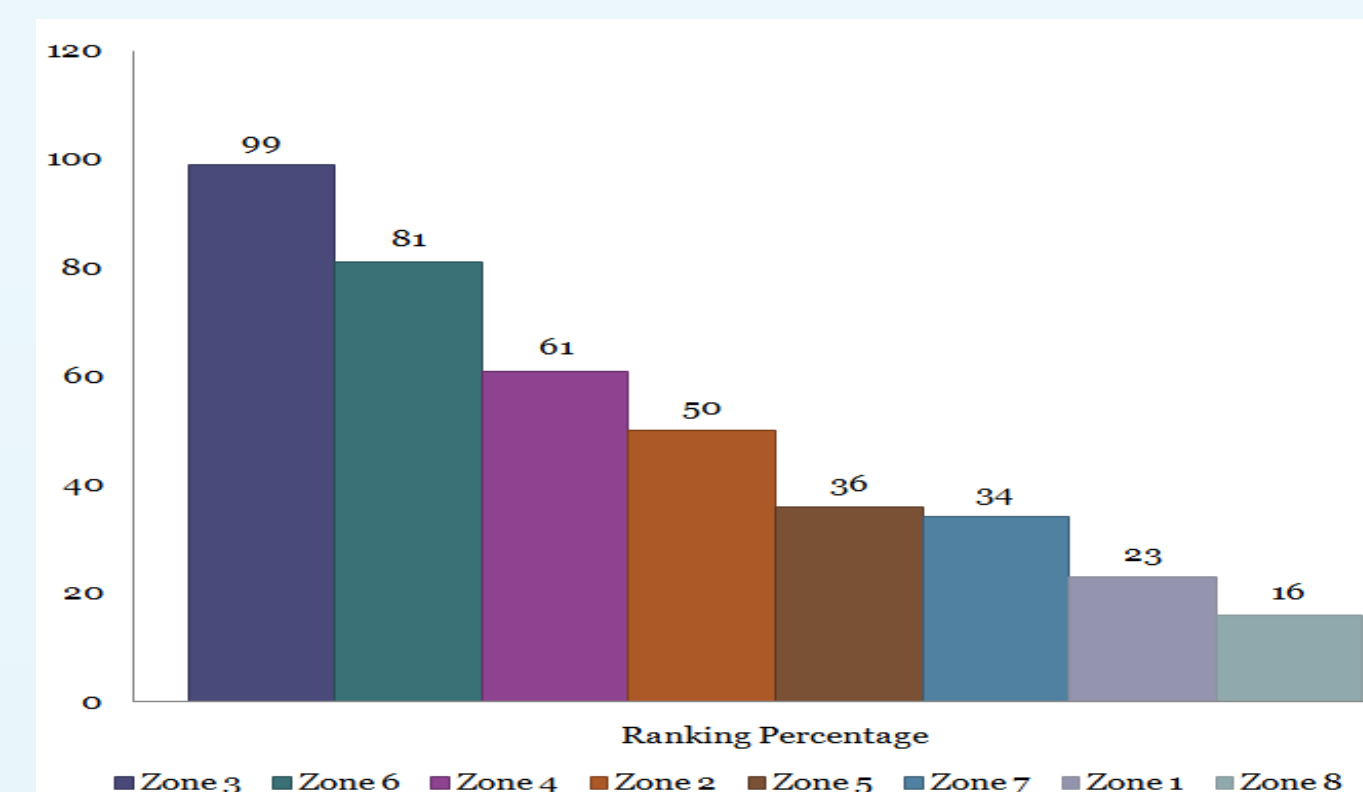
Results



Graph 1. Ranking percentage of the cypriot coastal zone, without considering any scenario.



Graph 2. Ranking percentage of the cypriot coastal zone, considering most important environmental impact of a pollution incident.



Graph 3. Ranking percentage of the cypriot coastal zone, most important economic impact of a pollution incident.

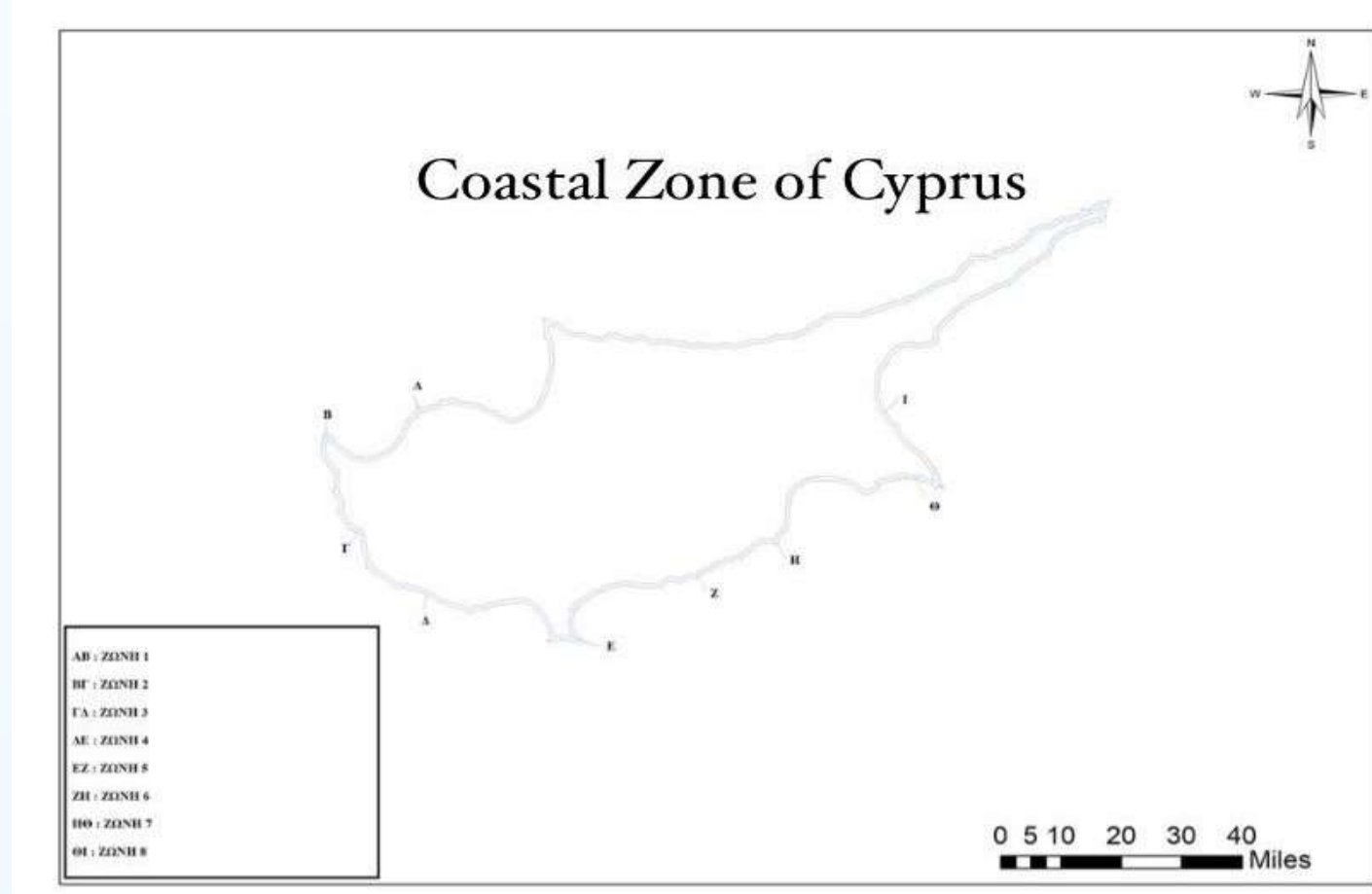
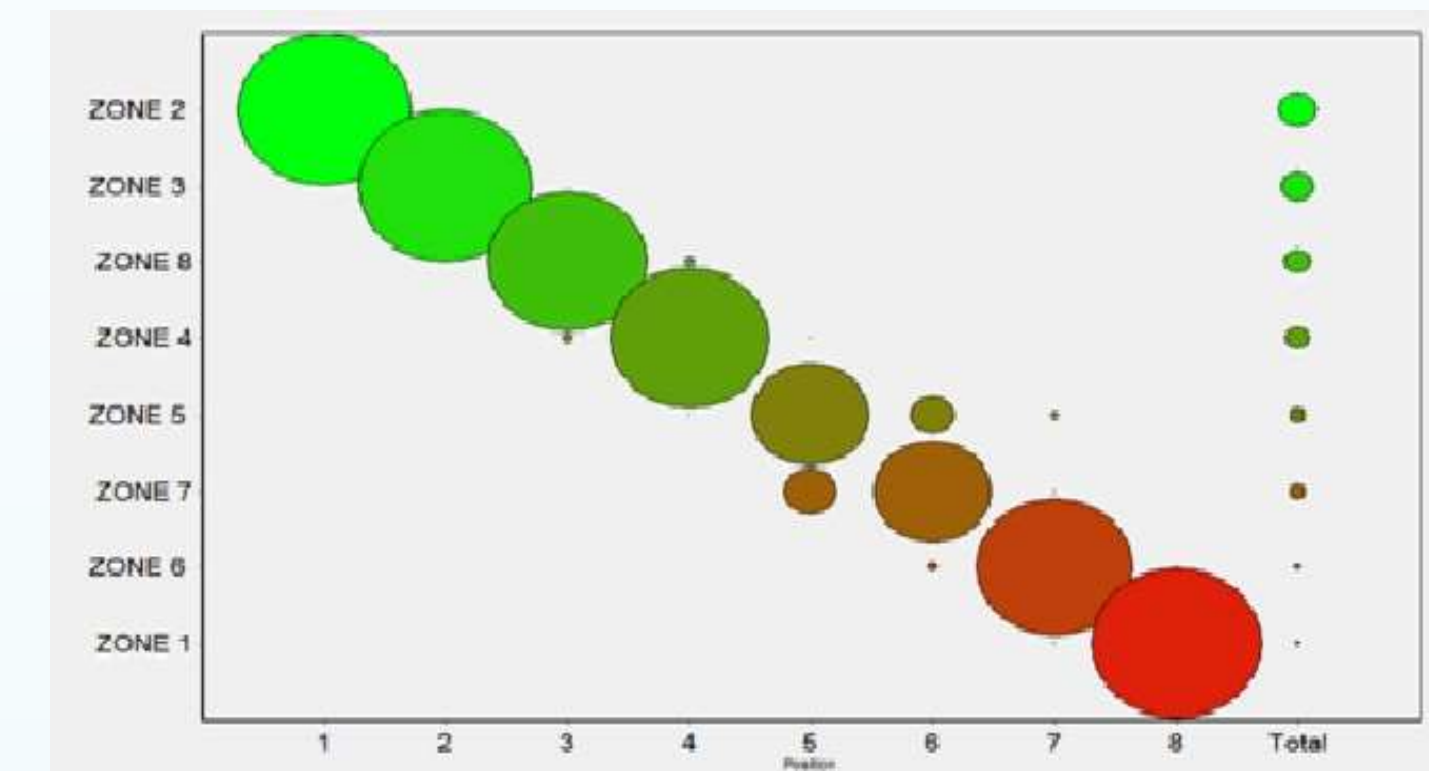


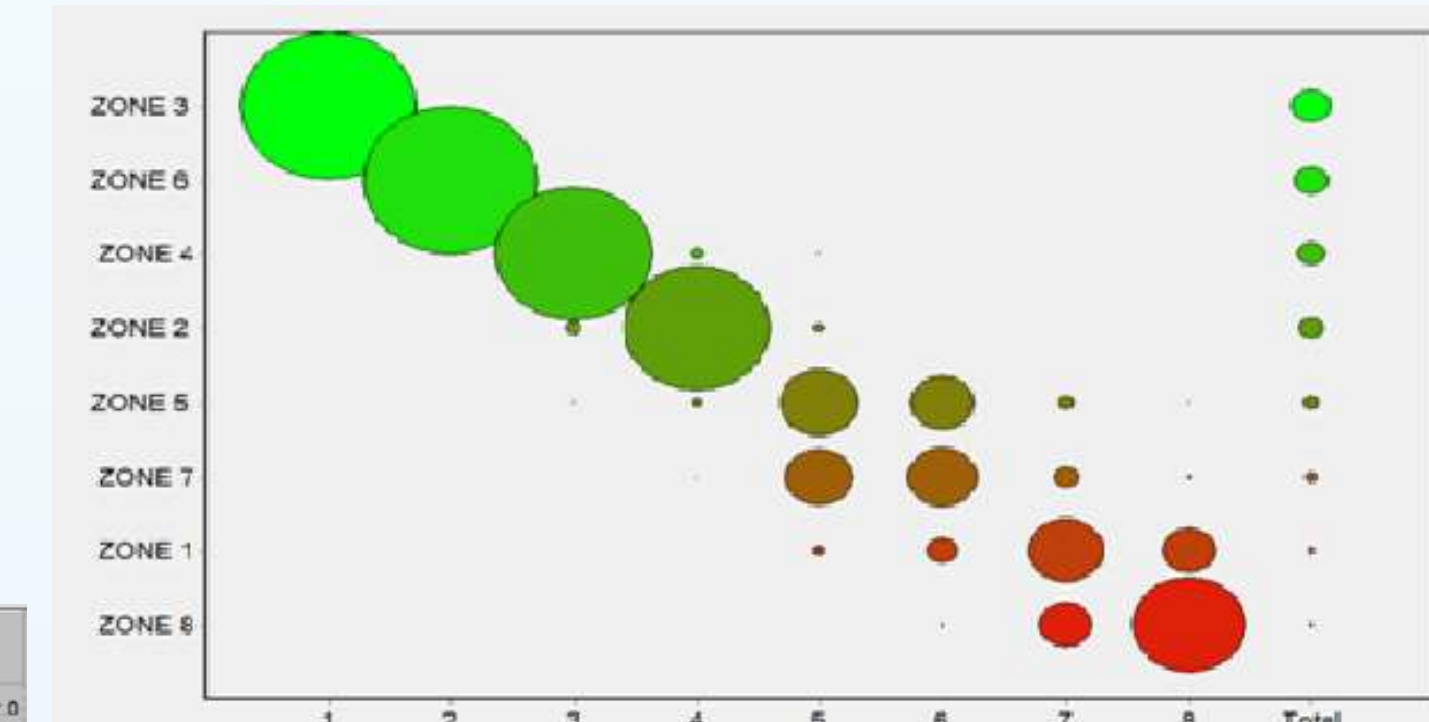
Figure 1. Map of the coastal area of Cyprus divided into 8 different zones. Each one represents the alternative choices for which the multi-criteria method will be applied.

CG	Unit	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8
MARINE PROTECTED AREAS	ordinal	3.0	3.0	2.0	2.0	2.0	2.0	3.0	2.0
AQUACULTURES	ordinal	0.0	0.0	1.0	1.0	0.0	1.0	0.0	0.0
URBAN AREA	ordinal	2.0	1.0	2.0	2.0	2.0	3.0	2.0	2.0
TYPE OF COAST	ordinal	2.0	2.0	1.0	2.0	3.0	2.0	2.0	2.0
COASTLINE	kilometers	35.50	36.40	30.00	53.90	40.00	24.90	53.10	30.00
RIVERS	ordinal	4.00	4.00	3.00	3.00	3.00	2.00	2.00	2.00
BEACHES	percentage	0.0002	0.0002	0.0021	0.0025	0.0404	0.1004	0.0008	0.0172
WIND DIRECTIONALITY FEBRUARY	ordinal	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00
WIND DIRECTIONALITY APRIL	ordinal	2.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00
WIND DIRECTIONALITY JULY	ordinal	2.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00
WIND DIRECTIONALITY OCTOBER	percentage	2.00	4.00	4.00	4.00	2.00	3.00	3.00	3.00
CURRENT'S DIRECTIONALITY FEBRUARY	ordinal	2.00	2.00	3.00	2.00	2.00	2.00	2.00	4.00
CURRENT'S DIRECTIONALITY APRIL	ordinal	1.00	3.00	3.00	2.00	3.00	2.00	2.00	4.00
CURRENT'S DIRECTIONALITY JULY	ordinal	2.00	4.00	4.00	2.00	2.00	2.00	2.00	2.00
CURRENT'S DIRECTIONALITY OCTOBER	percentage	2.00	4.00	4.00	2.00	2.00	1.00	1.00	3.00
NATURAL AREAS	percentage	0.0043	0.0119	0.0036	0.0152	0.0947	0.0100	0.1237	0.1232

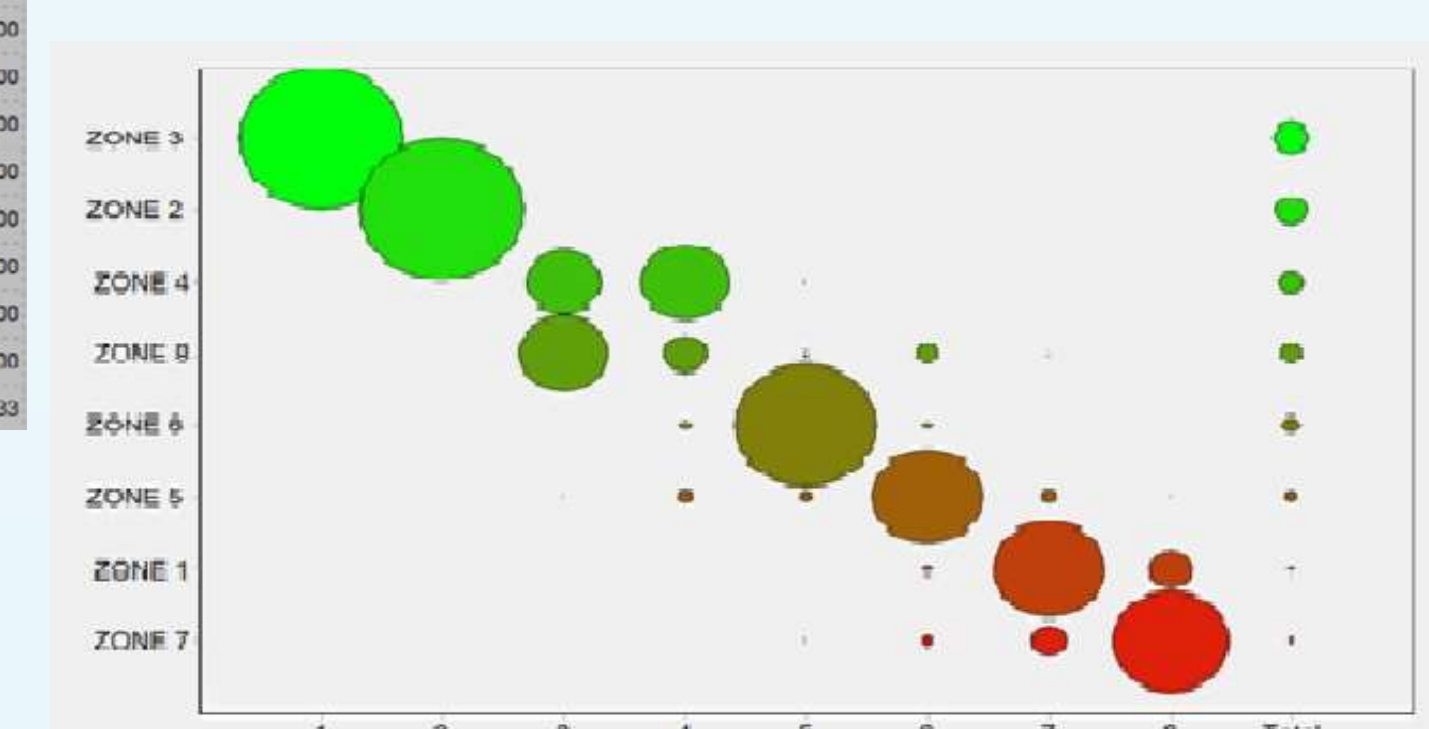
Figure 2. Regime impact matrix, which includes the evaluation criteria and alternative choices (zones). All of the criteria in this study, are considered benefits.



Graph 4. Sensitivity analysis, without considering any scenario.



Graph 5. Sensitivity analysis, considering most important environmental impact of a pollution incident.



Graph 6. Sensitivity analysis, considering most important economic impact of a pollution incident.

Conclusions

- The economy of the urban areas will be affected in case of a pollution incident (**Zone 3**), including also the areas that are close to the cities (**Zone 6 and 4**).
- The zones covered from **Natura 2000** areas, **Posidonia oceanica** meadows and **natural lands** are vulnerable in case of a pollution scenario considering the environmental impacts (**Zone 2**).
- Combining spatial information in the quantitative ranking of the vulnerability of the cypriot coastal zone, will lead to understand the way the human activities and natural processes influence the region
- Ranking of the coastal area of Cyprus by applying this method = tool or proposal for **Coastal Management Plan** for the prevention of pollution incidents
- The results of the multi-criteria method can be used as a basis for the implementation of a **Coastal Management Plan**

References

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