APPLICATION OF ArcSDM EXTENSION FAVORIBILITY MODELLING OF STONE AGGREGATE

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Scope

• GIS based modelling for stone aggregate potential
• Geology of Croatia
• Mineral resources of Croatia and Dalmatia
• Extraction sites in Dalmatia and aggregate production (study area)
• Method: Weights of evidence (WofE)
• Results: areas suitable for aggregate stone quarries in Dalmatia
• Future prospects of mineral aggregate extraction and land use conflicts
Geology of Croatia

- >50% carbonate rock
  (limestone and dolomite mainly of the Mesozoic Adriatic Carbonate Platform)
- 40% thick unconsolidated Quarternary sedimentary deposits
- <5% eruptive and metamorphic rocks
Mineral resources of Croatia

Mineral commodity:
- crushed stone aggregate; 253 sites
- dimension stone aggregate; 103 sites
- sand and gravel; 82 sites
- clay; 49 sites
- bauxite; 15 sites
- gypsum; 9 sites
- other non metal deposits
- coal in the past

- 626 TOTAL NUMBER OF EXPLOATION SITES IN CROATIA (378 km²)
Quarrying in Dalmatia

- 68 active crushed stone aggregate quarries or 25% in Dalmatia
- 82 active dimension stone aggregate quarries or 80% in Dalmatia
Quarrying in Dalmatia

- exploitative reserves of dimension stone aggregate 13.5 mill. m³ in the study area
- exploitative reserves of crushed stone aggregate 350 mill. m³ in Croatia (25% in Dalmatia)
- increasing demand for aggregate in EU, as well in Croatia
Quarrying in Dalmatia

Traces of old Roman quarries can be found along the coast, together with ruins of public buildings, basilicas and temples.

Today export destinations include Italy, Germany, Austria, Belgium, the Netherlands, Slovenia, Bosnia - Herzegovina, Czech Republic, UK, South Korea and Australia.

Limestones exclusive to the Dalmatia include Veselje, Adria Grigio, San Giorgio, Rasotica, Dracevica and Zecevo.
Weights of evidence (WofE)

- quantitative method
- for mineral-potential mapping by Bonham-Carter, Agterberg, and Wright (1988)
- response variable (training points)
- predictor variable (evidential theme)
- analyze spatial associations between variable
- reclassification the evidence categories
- define optimal prediction
- three evidential theme layers were used:
  - bedrock maps with appropriate quality attributes
  - proximity to principal highways and road lines
  - categorical groups define by census tract population density
- all evidential theme layers were prepared in grid format using Arcview 9.1 and ArcSDM extension was developed by Don Sawatzky under the direction of Gary Raines (USGS) and Graeme Bonham-Carter (GSC)
Weights of evidence (WofE)

- predictive evidence
- population density (people per square km)

source: Digital Atlas of Republic of Croatia, scale 1:100 000 from GIS DATA
Weights of evidence (WofE)

- predictive evidence
- transportation network
- distance from transportation corridors within 2 and 4 km
- 90% crushed stone aggregate quarries are within 2 km of principal roads
- the importance of proximity to transportation roads for the industry

source: Digital Atlas of Republic of Croatia, scale 1:100 000 from GIS DATA
Weights of evidence (WofE)

- bedrock lithology
- predictive evidence
- compilation of 1:100 000 scale basic geological maps of Republic of Croatia
- 20 maps sheets in digital format
- potential maps for stone aggregate in the study area
Results

Method demonstrates a technique to define suitable areas for aggregate production using geological map, transportation network and population density spatial data for evidence.
Future prospects

To rise awareness to various mining problems and impacts on karst and to help manage better the use of mineral resources in Dalmatia based on identification of more suitable areas for stone production taking in account both environmental and marketplace restrictions and to help local environmental policy makers to correctly manage the fragile karst environment and to preserve the natural landscape.
Future prospects: Mineral resource potential and land use restrictions

Case study: Šibensko-kninska county - Dalmatia
• geological potential for mineral resources
Future prospects: Mineral resource potential and land use restrictions

Šibensko-kninska county - Dalmatia-administrative restrictions in context of mineral exploitation (central and local government agencies)

- road infrastructure
- protected areas
- valuable land
- 1 km distance from the coast
- tourist resorts
- settlements
Restricted mineral potential and spatial planning

Šibensko-kninska county - Dalmatia
• road infrastructure
• protected areas
• valuable land
• 1 km distance from the coast
• tourist resorts
• settlements (500 m distance buffer)
• visual impacts on the landscape (viewshed)
Restricted mineral potential and most favorable areas for dimension stone extraction

Arc SDM WofE favorability map for dimension stone extraction

Šibensko-kninska county - Dalmatia
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Restricted mineral potential and most favorable areas for aggregate extraction

Šibensko-kninska county -
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Future prospects

Future goals are to:
Apply GIS-WofE modeling to determine most favorable areas for quarring in terms of geology, environmental protection and county master planning and derive a model procedure applicable to spatial planners for the whole territory of Croatia
Fold in Eocene deposits
A proposed protected geological site
Kapelić spring, Moseć

Thank you!