DPSIR waste management framework and monitoring approach

Izidora Marković Vukadin, PhD
CROSTO at glance

- CROatian Sustainable Tourism Observatory
- Established in 2016
- Member of INSTO from 2016
- NUTS 2 level Adriatic Croatia
- 15 core indicators (ETIS+UNWTO)
- NUTS 2 level measurements from 2017
- Destination level measurements from 2018 (12 destinations)
## CROSTO indicator list

### CROSTO core indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>UNWTO mandatory issue</th>
<th>ETIS section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of residents who are satisfied with tourism</td>
<td>Local satisfaction with tourism</td>
<td>C Social and cultural impact</td>
</tr>
<tr>
<td>Number of tourist nights per 100 residents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of tourists who are satisfied with overall experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of repeat/return tourists</td>
<td></td>
<td>A Destination management</td>
</tr>
<tr>
<td>Percentage of tourism enterprises using voluntary certification/labelling for environmental CSR</td>
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### Percentage

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Category</th>
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</thead>
<tbody>
<tr>
<td>Number of tourist nights</td>
<td>Destination economic benefits</td>
</tr>
<tr>
<td>Daily spending per tourist overnight</td>
<td>B Economic value</td>
</tr>
<tr>
<td>Direct tourism employment as percentage of total employment</td>
<td>Employment</td>
</tr>
<tr>
<td>Gross annual occupancy rate in commercial accommodation</td>
<td>Tourism seasonality</td>
</tr>
</tbody>
</table>

### Energy management

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy consumption per tourist night compared to general population energy consumption per resident night</td>
<td>Energy management</td>
</tr>
<tr>
<td>Water consumption per tourist night compared to general population water consumption per resident night</td>
<td>Water management</td>
</tr>
<tr>
<td>Percentage of sewage from a destination treated to at least secondary level prior to discharge</td>
<td>Waste water (sewage) management</td>
</tr>
<tr>
<td>Waste production per tourist night compared to general population waste production per resident night</td>
<td>Solid waste management</td>
</tr>
</tbody>
</table>

### Solid waste management

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of destination area out of the settlement’s boundaries built for tourist purposes</td>
<td>Governance</td>
</tr>
</tbody>
</table>

### Governance

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<th>Indicator</th>
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</tr>
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<tr>
<td>Percentage of the destination area within the construction zone of the settlement where the facilities of catering and tourist purposes</td>
<td>Governance</td>
</tr>
</tbody>
</table>

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**Note:** This table summarizes key indicators for assessing the economic, social, and environmental impact of tourism, as outlined by the United Nations World Tourism Organization (UNWTO) and the European Tourism Information System (ETIS). Each indicator is categorized under specific sections for better understanding and management purposes.
Waste production by tourists in relation to residents’ waste production

• Based on total amount of solid waste produced in 2019, number of residents and number of tourists overnights in 2019

• Limitations:
  – Includes only commercial accommodation
  – Patterns of consumption

Counties: IS Istria, PG Primorje-Gorski Kotar, LS Lika-Senj, ZD Zadar, SK Šibenik-Knin, SD Split-Dalmatia, DN Dubrovnik-Neretva
Comparison of regional and local level

The production of municipal waste by tourists compared to the production of municipal waste by permanent residents

- LSŽ
- Novalja
- DNŽ
- Dubrovnik
Waste management DPSIR framework

• When selecting DPSIR elements, some of the basic issues from which their selection arises were:
  – Who produces waste?
  – Who manages waste?
  – What quantities of waste are generated?
  – In what way is tourism, especially seasonality, a driver?
  – What are successful responses in waste management?
The DPSIR framework for waste management issues in tourism

**Source:** EEA, 2014.; MZOE, 2019.
### Additional waste indicators - Municipal waste from stationary tourism in Adriatic Croatian counties

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantities of municipal waste from stationary tourism in coastal Croatian counties (t)</th>
<th>Share of municipal waste from stationary tourism in coastal counties in total municipal waste generated in Croatia (%)</th>
<th>Equivalent to No. of residents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>99.149</td>
<td>5,4</td>
<td>259.552</td>
</tr>
<tr>
<td>2015</td>
<td>112.111</td>
<td>6,0</td>
<td>290.444</td>
</tr>
<tr>
<td>2016</td>
<td>135.396</td>
<td>8,3</td>
<td>345.848</td>
</tr>
<tr>
<td>2017</td>
<td>148.432</td>
<td>9,1</td>
<td>356.807</td>
</tr>
<tr>
<td>2018</td>
<td>159.332</td>
<td>9,3</td>
<td>368.823</td>
</tr>
</tbody>
</table>

Generated waste per County

Specific quantities of generated municipal waste in 2018 by counties, kg / inhabitant

Source: MZO, 2019.
Waste recovery

Municipal waste recovery rate by counties with additionally determined quantities in 2018

Municipal waste management scenarios in Adriatic Croatian counties in 2019
The DPSIR framework for environmental issues on the Island of Krk

**DRIVERS**
- Industry & development
- Tourism seasonality & Recognized weekend destination
- Concentration of the overall Croatian tourist demand
- Littoralisation – Apartmentizations, Urbanization & Touristification
- Facilities and infrastructure demand
- Transport & Transit Island (nautical tourism, public roads)
- Critical zones: Omišalj Port and Economics Zone (petrochemistry, pipeline), Airport Rijeka, Vrbiska Port, country road and Krk bridge

**PRESSURES**
- Tourism, construction & infrastructure intensity
- Tourism activities concentrated on the coast
- Pollution – Emission into the air, water and soil
- Waste management & water supply and drainage & electricity system load (abstractions of resources)
- Excessive use of recreational resources
- Diffuse source pollution (high car traffic)
- Land use for waste management facilities

**IMPAIRS**
- Threats on human health and well-being
- Wildlife, biodiversity and forests
- Exhaustion of natural resources

**RESPONSES**
- Regulations
- Cooperation between local authorities
- Economic Instruments (incentives, subsidies, taxes)
- Environmental management standards
- Waste management practices
- Sustainable management plans and programmes
- Innovative sustainable / Education and reporting
- Awareness and behavior
- Long-term vision and programmes: Energy Independent and Smart Island

Source: Zovko et al., 2021
Krk example

One of the 10 best European eco-islands with the plan to become the first energy-independent green Mediterranean island with ‘zero CO2 emission’

Quantities of separately collected waste in tons, in 2021 (by months and by types)
Krk example - Society responses

- In 2005 (company Ponikve d.o.o.) established an ecological waste management system on the entire island
- The project Door-to-Door has been implemented with the aim of increasing the level of recycling and separation of collected municipal waste
- In 2019 the share of the separated waste exceeded more than 55% of total quantities of municipal waste
- The success of the company Ponikve d.o.o. is the result of long-term quality cooperation with local leadership, municipal wardens, local associations, and the population
Krk example - Society responses

- The almost zero waste vision of the Island of Krk is presented through various educational and incentive programs:
  - Island Flower
  - Donating compost to households
  - Sharing pocket waste bins
  - Eco workshops and cleaning activities
  - Promotional and educational materials on recycling

- The success of the program Eco Island of Krk can be attributed to the active and permanent participation and conscientious behavior and awareness of the business sector.
THANK YOU FOR YOUR ATTENTION

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Participatory process in measuring sustainability: Case of CROSTO, INSTO 2021