Improvement of water supply on inhabited Croatian islands

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Croatia and its islands

A country with thousand islands

718 islands

467 reefs and rocks

Islands present approx 5.3% of Croatian surface (Islands surface vary from 0.3 to 409.9 km²)

Only 47 are inhabited (No. of inhabitants vary from 2 to 16,200)
Main geographical features

- The climate is typically Mediterranean
- Soil zones are very rarely remarkable
- Cultivation of olives, grapes, cereals, vegetables, figs and almond is dominant
- The industry is characteristic only for bigger and densely inhabited islands
- Some parts of islands try to affirm the advantages of the preserved natural phenomena (eg National park Kornati, Mljet, Brijuni, Nature Park Telaščica)
Islands water resources

- Almost all islands are formed of carbonate
- In general there is **no superficial running water**
- Among **a few freshwater lakes** most significant is Vransko jezero on the island Cres
  - Some brackish lakes are present, too
- The permanent **springs** with higher capacity are located at a few bigger islands (often brackish)
The aim of this study

- Islands are of crucial importance for Croatia due to depopulation trend and their tourist attraction
- One of the most limiting factor in their development is undeveloped water supply system

- The aim of this study was to scan prevalent conditions and to propose optimal solution for water supply on each inhabited island

- Rounds of all inhabited islands were made between summer 1999 and summer 2000
Water level depends on precipitation
- mean annual precipitation from 400 – 1200 mm
- decreasing from north to south
- from land to open sea

Present islands water supply

- Among all inhabited islands only 9 use their own resources
- Other islands have solved water supply in different ways:
  - through water input from the inland
  - by a water carrier
  - rainwater harvesting
  - from private boreholes and wells
Present islands water supply

- A brackish water desalination plant was put into operation:
  - on the island Lastovo in 1997
  - three plants on Mljet in 1999
  - one on Dugi otok in 2005
Present islands water supply

- **Will solve the water supply by water input from the inland in the near future**: 26%
- **Have solved the water supply**: 24%
- **Did not solve the water supply at all**: 39%
- **Have not solved the water supply entirely**: 11%
Water quality

- 119 water samples were taken by random from:
  - the existing groundwater well fields (14)
  - the wells and boreholes (66)
  - the springs (21)
  - the lakes (16)
  - the pits (2)
- The chemical analyses were performed (TDS, TOC and salinity are taken into account in this study)
Water quality

- On the islands which *have not solved the water supply entirely* and which *did not solve the water supply at all* water quality is often not satisfying.

- 66 % samples have TDS higher than 1000 mg/L.

- Even if TDS does not affect human health, it is not recommended in amounts higher than 1000 mg/L.
Desalination plants

1. Permanent (>15 l/s)
sea- 576 m³  
brackish- 1323 m³
2. PERMANENT FOR A SPECIFIED TIME (<15 l/s)
- brackish water – to 1300 m³ or to 15 l/s
- sea – to 600 m³ or to 6,6 l/s
3. PERMANENT MOBILE PLANTS
(all remaining)
Suggestions for water supply improvement

- The islands which have not solved water supply entirely
  - **Cres** has huge amounts of its own water (Vrana lake)
  - **Pag, Hvar** and **Korčula** are partially connected to the inland, there are the local groundwater well fields
  - **Mljet** has three desalination plants
- Still they have problem with water supply
Suggestions for water supply improvement

- The islands which have not solved water supply entirely
  - CRES
    - Although Cres has huge amounts of its own water it is not justified economically to install the water supply system onto each outlying and poorly inhabited community, rain harvesting and supplying water in a tank are better solutions
  - PAG, HVAR, KORČULA AND MLJET
    - Posses huge amounts of brackish waters
    - Could solve their problems by installing desalination plants on the existing groundwater well fields or boreholes
Suggestions for water supply improvement

- The islands which have not solved water supply at all
  - Small islands at a large distance from the inland with smaller population concentrated in a small area
  - Water supply has been performed mainly by water transport using water carriers
  - Possess huge brackish water quantities
  - It would not be economically justified to bring water from the inland
Suggestions for water supply improvement

- Local pumping station, tank and a network on Unije
- Tanks and networks on Silba, Premuda and Molat
- The rest of the small islands have tanks
- The optimum would be to install a desalination plant and to deposit that water in the already existing reservoirs
Suggestions for water supply improvement

- Different desalination plant could be suggested:
  - permanent for a specified time period: Unije, Silba, Olib, Ist, Molat and Iž
  - permanently mobile plants: Susak and Premuda
Suggestions for water supply improvement

- **Dugi otok** and **Vis** are big islands at the largest distance from the inland with huge quantities of brackish water.

- Could solve its water supply using the local desalination plants.
  - Dugi otok - permanent for a specified time period.
  - Vis - a central permanent desalination plant based on the groundwater well field **Korita**.
Suggestions for water supply improvement

- Male Srakane, Vele Srakane, Sestrunj, Zverinac, Rava and Biševo

- could solve the water supply by rain harvesting using their own tanks, which could be filled by a water carrier or by a permanently mobile desalination plants during summer.

- The island Rivanj - a permanent solution would be a connection with a nearby island Ugljan (connected to the Regional Water Company North Dalmatia)
Conclusion

- The bigger islands have quite satisfying water supply
  - the population density and habitation pattern influence the extent to which consumers are supplied by piping networks

- The islands at a larger distance from the inland are usually supplied by water transport from the inland or with water from their own tanks, boreholes or wells
  - water quality is often not satisfying
Conclusion

- **The water input from the inland** is the right solution for bigger islands and those closer to the inland (Rivanj – connection over Ugljan)

- **Rain harvesting** and its retention in the underground or on the surface could be a solution for: Male Srakane, Vele Srakane, Sestrunj, Zverinac, Rava and Biševo

- **Desalination** could solve the problem especially for the islands at a large distance from the inland:
  - permanent desalination plants (Vis and Korčula)
  - permanent for a specified time period (Pag, Dugi otok, Hvar, Mljet, Unije, Silba, Olib, Ist, Molat and Iž)
  - permanently mobile plants (Susak and Premuda)
Perspective

- The existing resources of fresh- and brackish water must be protected

- Additional hydrogeological research of quantity and yields must be carried out

- Special attention must be paid to the waste management
  - since most of the islands do not treat domestic effluents
Thank you!