

# SUSTAINABLE MANAGEMENT OF WATERS IN COASTAL AREA: THE CASE STUDY OF RIMINI (ITALY)



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## TYPICAL VIEW OF THE ADRIATIC RIVIERA



- The Northern Adriatic coastland is characterized by locations of great tourist interest, such as the Romagna Riviera, and areas with a very precarious environmental setting, such as the Valli di Comacchio and the Po River Delta. Therefore, a correct coastal management has to be made with the utmost care

## TYPICAL MORPHOLOGY OF THE EMILIA-ROMAGNA LITTORAL

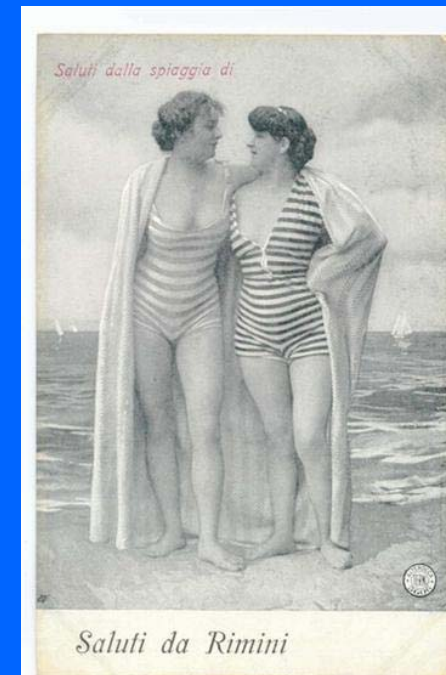
- The Emilia-Romagna littoral is 130 km long; from an administrative point of view it can be divided into 14 different Municipalities belonging to the Rimini, Forlì, Ravenna and Ferrara Provinces.
- The morphology of the littoral is represented mainly by sandy beaches and shallow waters



- The coast included between Cattolica and the Po mouth is made up of a single sandy beach 110 km long where many rivers flow into the sea

## CHANGES DURING TOURISM GROWTH

- The beginning of tourism activities in Rimini started in 1843 and the Grand Hotel was built in 1906
- In the following years started the development of some villages in the surrounding
- In the '20 begins the mass tourism; it grows more in the '50 and '60
- At the beginning of the '60, Rimini has 3000 hotels and 8000 villas.
- Today these data are doubled



## RIMINI: A CROWDED SEASIDE RESORT

In the last century the littoral has undergone to a high development through an intensive recourse to tourism activities; the morphology has therefore changed very much having as a result a complete different aspect.



- Rimini is a city in the Emilia-Romagna region of Italy and capital city of the Province of Rimini. It is located on the Adriatic Sea near the coast between the rivers Marecchia and Ausa. Coast navigation and fishing are traditional industries and, together with Riccione, it is probably the most famous seaside resort on the Adriatic Riviera.

## MAIN ENVIRONMENTAL IMPACTS IN COASTAL AREAS

- discharge into the sea of treated (untreated) wastewater
- runoff of polluted agriculture waters ;
- polluted liquid spills ;
- untreated domestic waters ;
- port activities producing air and water pollution, noise, oil spills, etc;
- terrestrial and marine traffic producing air and acoustic pollution. congestion, etc;
- seasonal overproduction of municipal waste water during the intensive presence of tourism activity.

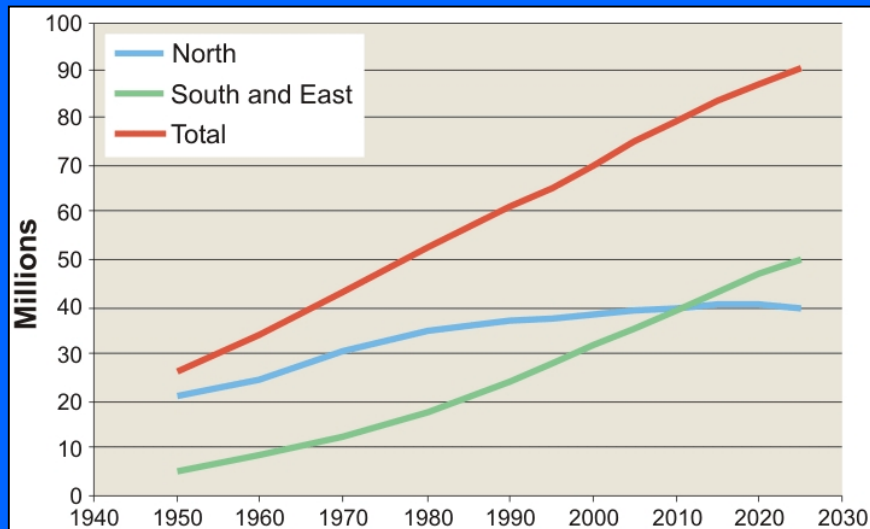
## ENVIRONMENTAL VULNERABILITY OF COASTAL AREAS

- High level of biodiversity, especially in coastal wetlands;
- High concentration of many marine organisms in sea water close to the coast;
- Woods and especially pine woods close to the coast, continuously threatened by the ingress of salt water due to the lowering of the fresh water table;
- Subsidence due to water and gas extraction from underground;
- Limited availability of potable water for industrial, agricultural and civil uses;

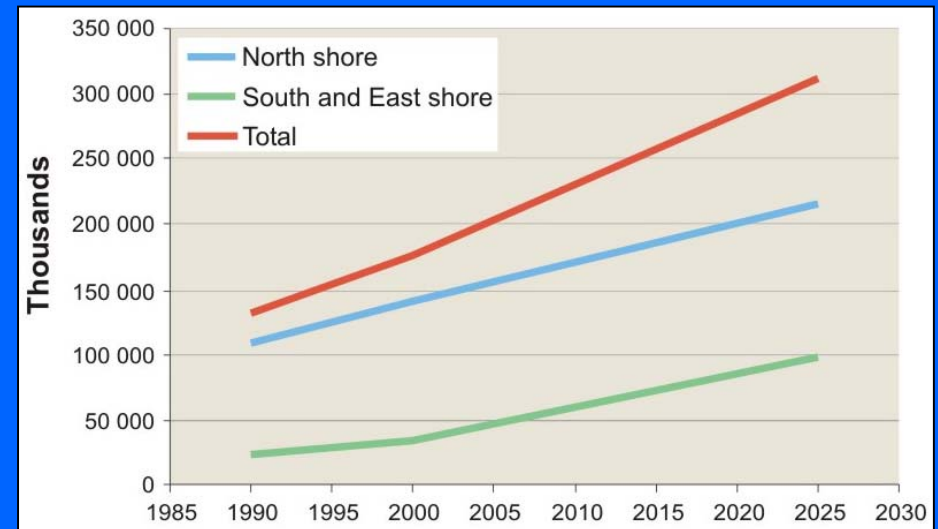
## COASTAL AREAS NEEDS A CAREFUL INTEGRATED MANAGEMENT

- It is well known that in coastal areas are concentrated many human activities and the population density is very high (industry, transportation, fisheries, agriculture, tourism, etc.)
- Coastal tourism produces during summer a peak of human presence giving an important contribution to the pressure on the fragile coastal environment
- Coastal areas are unique resources that need to be protected through a careful territorial planning in the framework of an integrated management.
- Water and its cycle represent one the most important resources in the framework of an integrated coastal management

## POPULATION AND TOURISM GROWTH IN MEDITERRANEAN BASIN (1950-2025)



Evolution of population in coastal cities located in Mediterranean basin



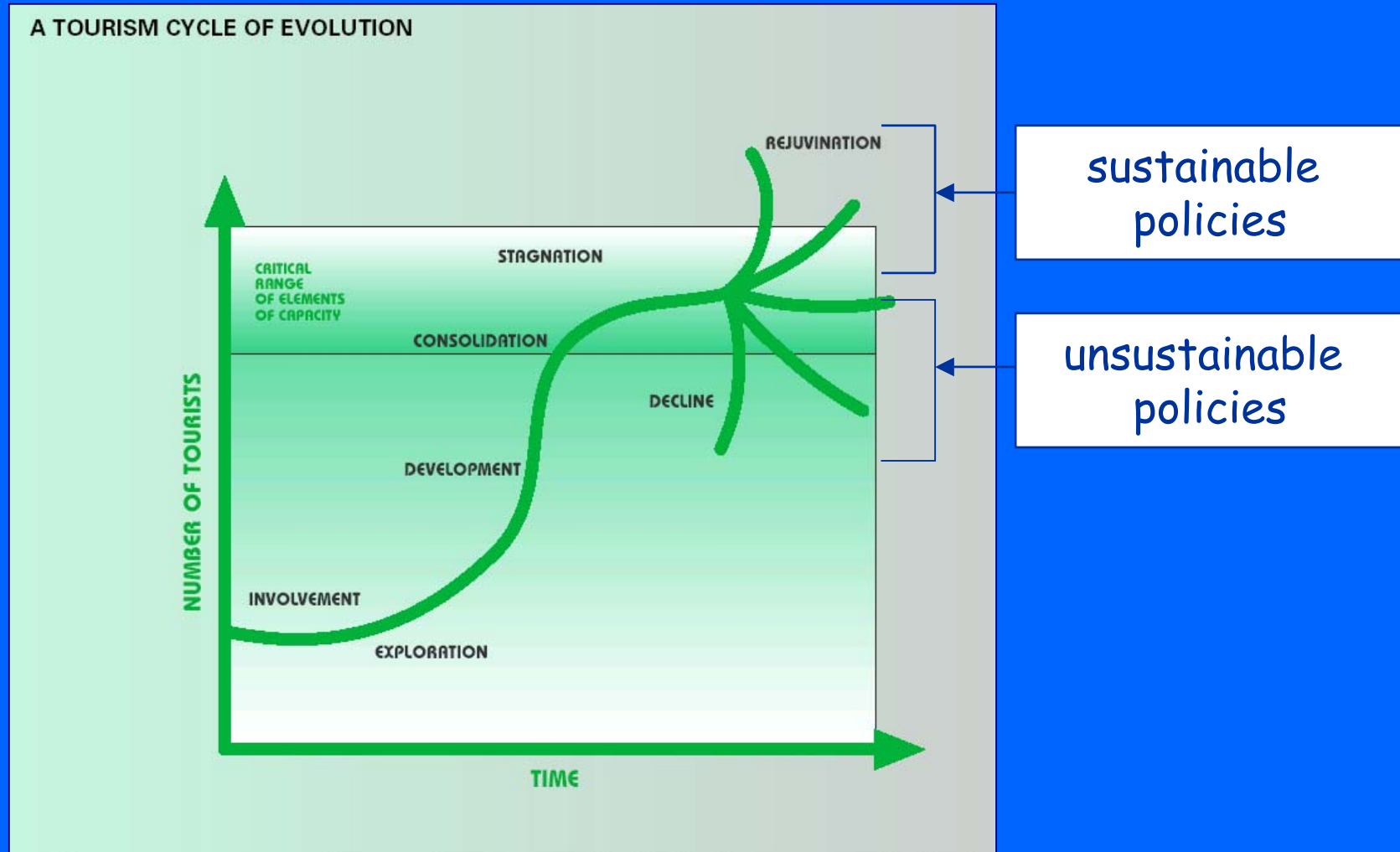
Evolution of tourism in Mediterranean basin

**Fonte:** [http://www.planbleu.org/red/ppt/Littoral\\_uk.ppt](http://www.planbleu.org/red/ppt/Littoral_uk.ppt)

## MAKING COASTAL TOURISM MORE SUSTAINABLE

- The common objective of all tourism activities is an adequate level of sustainability able to satisfy the development requirements without compromising the environmental quality
- The public institutions play an important role in developing environmental friendly policies able to stimulate public and private operators to follow their example
- Some tools regulated by European Directives are available to give a concrete support in the way of an improvement in sustainability:
  - Environmental Impact Assessment (EIA) .
  - Strategic Environmental Assessment (SEA) .
  - Environmental Management Systems (EMS).
  - Life Cycle Assessment (LCA).
  - European Union Eco-Label.
  - Local AGENDA 21.

# TOURISM CYCLE EVOLUTION



*Fonte: R.W. Butler "The concept of a Tourist Area Cycle of Evolution: Implications for Management of Resources", Canadian Geographer, vol. 24, no. 1, 1980, p.7*

## TOURISM INDUSTRY OVERUSES WATER

- Fresh water, is one of the most critical natural resources.
- The tourism industry generally overuses water resources for hotels, swimming pools, golf courses and personal use of water by tourists.
- This can result in water shortages and degradation of water supplies, as well as generating a greater volume of wastewater.
- In dryer regions like the Mediterranean, the issue of water scarcity is of particular concern.  
An average Spanish city dweller uses approximately 250 litres of water per day, while the average tourist uses 440 litres.
- This number increases to 880 litres if the tourist uses accommodations with swimming pools and golf courses.
- Because of the hot climate and the tendency of tourists to consume more water when on holiday than they do at home, the amount used can run up to 440 litres a day. This is almost double what the inhabitant of an average Spanish city uses.

## WHERE DOES DRINKING WATER COME FROM?

- A clean, constant supply of drinking water is essential to every community.
- People in large cities frequently drink water that comes from surface water sources, such as lakes, rivers, and reservoirs: sometimes these sources are close to the community.
- Other times, drinking water suppliers get their water from sources many miles away; in either case, when you think about where your drinking water comes from, it's important to consider not just the part of the river or lake that you can see, but the entire watershed.
- More than 50 percent of the people in the United States, including almost everyone who lives in rural areas, use ground water for drinking and other household uses.

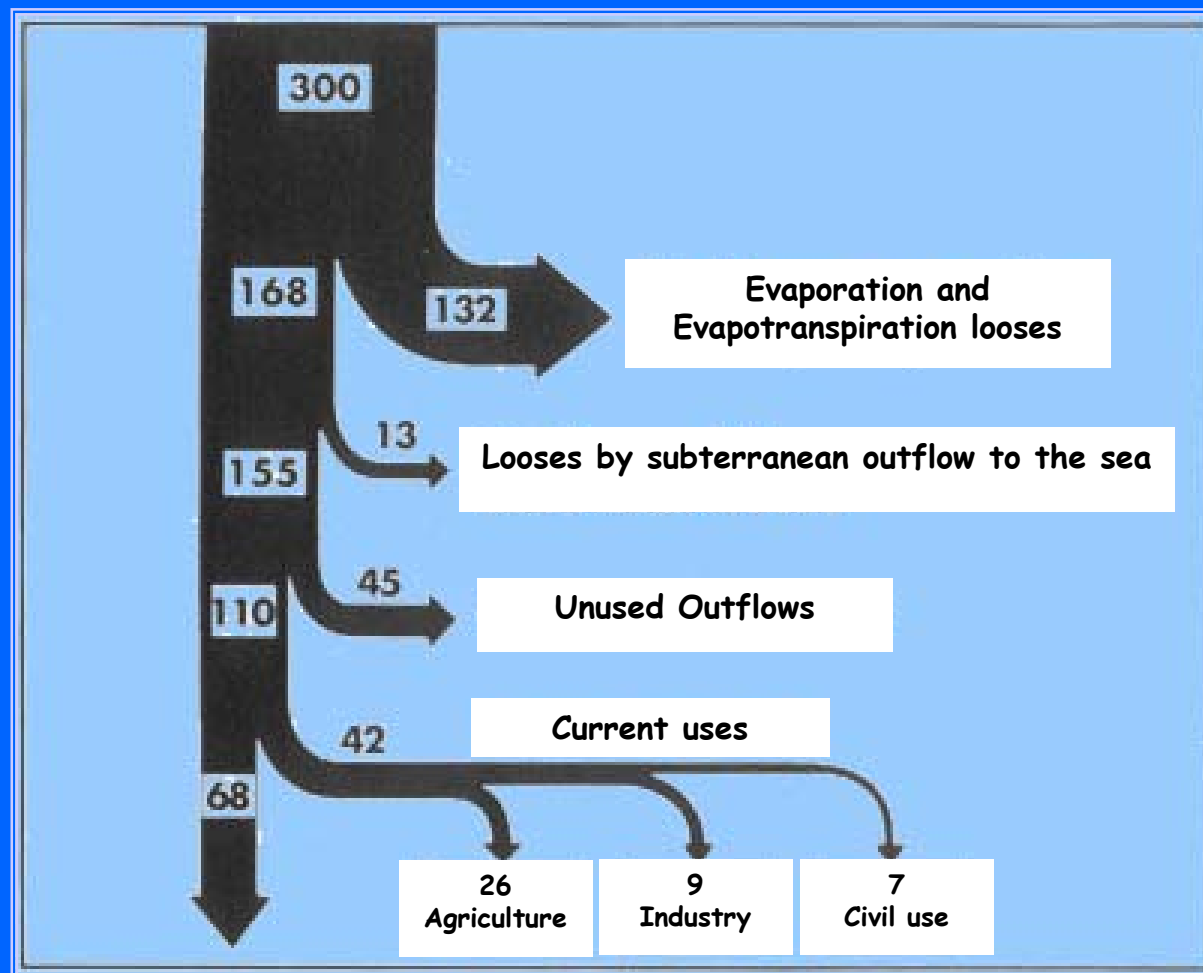
## SUBSIDENCE

- There is a limit to how much groundwater can be pumped out of an aquifer without causing depletion of the resource.
- If more groundwater is pumped out than is naturally recharged by precipitation, the amount of water stored in the aquifer will decline.
- In some areas, pumping has resulted in subsidence (sinking) of the land surface; similar conditions may arise from the pumping of petroleum or natural gas.
- Groundwater occupies volume in an aquifer by filling pore spaces between the mineral grains. because water is essentially incompressible, that water helps support the weight of the overlying rock and soil.
- When the water is pumped out, the pore spaces may collapse under the load and the volume of the rock and soil decreases; in many areas, that pore space is forever lost; that is, water cannot reenter the aquifer.

## HOW MUCH WATER IS CONSUMED IN ITALY

- The average consumption of water in Italy is about 900 cubic meter per person per year, the second greater consumer in Europe
- More than 65% of water is consumed for irrigation in agriculture, 30% being the average consumption in Europe
- 15-20% of water is consumed for domestic uses and the remainder 15-20% is used for industry and for hydroelectric
- Water supplied to the houses is used as follows:
  - 60% sanitary purposes
  - 22% washing clothes and dishes
  - 6% irrigation of gardens
  - 6% cooking and drinking
  - 6% others

# WATER PRECIPITATION (Billions m<sup>3</sup>) AND DESTINY IN ITALY

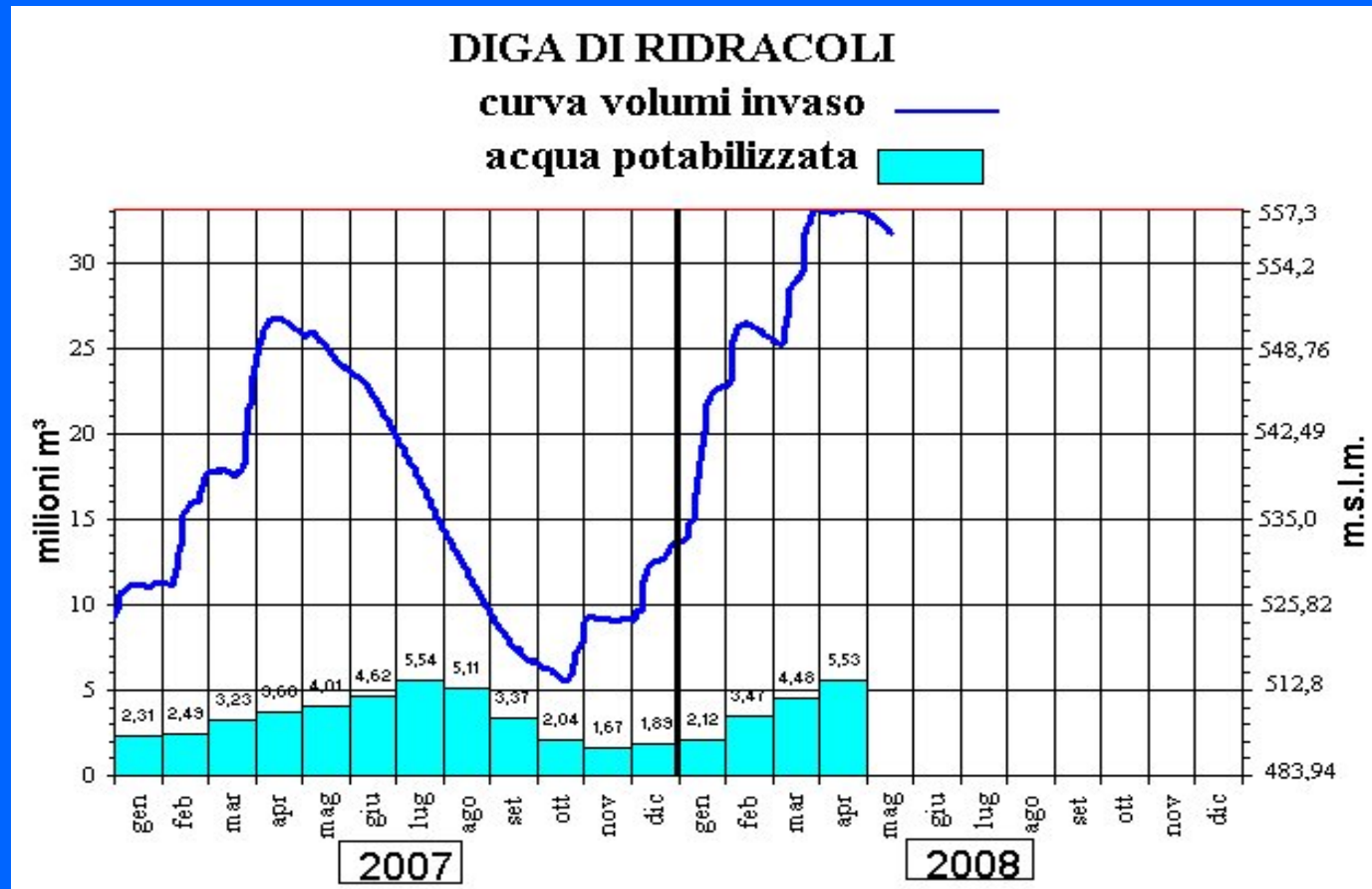


## THE WATER SUPPLY IN ROMAGNA LITTORAL

- Water supply for Romagna littoral relies on a mountain artificial basin (Ridracoli) covering a surface of 1,035 km<sup>2</sup> and having a volume of 33 millions cubic meters. The basin is able to deliver about 50 million cubic meters per year at a flow rate of about 3 cubic meter per second. 50 municipalities located in the Provinces of Ravenna, Forlì Cesena, Rimini and S. Marino Republic are served by this basin

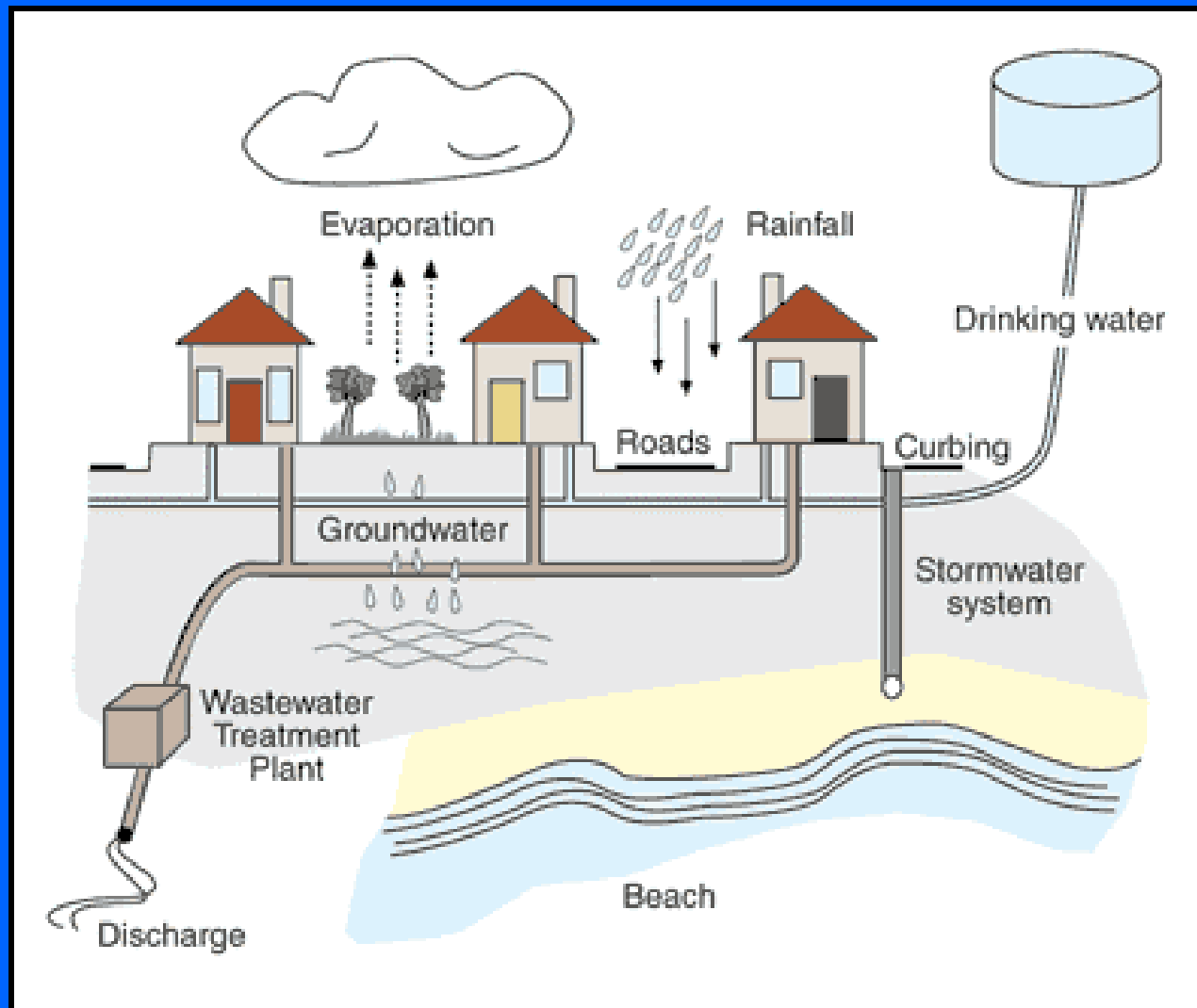


# INVENTORY AND LEVELS OF WATER IN RIDRACOLI BASIN DURING THE YEAR



**Fonte:** <http://www.romagnacque.it/azienda.html>

# TYPICAL WATER CYCLE IN COASTAL CITIES



Fonte: [www.cmmt.csiro.au](http://www.cmmt.csiro.au)

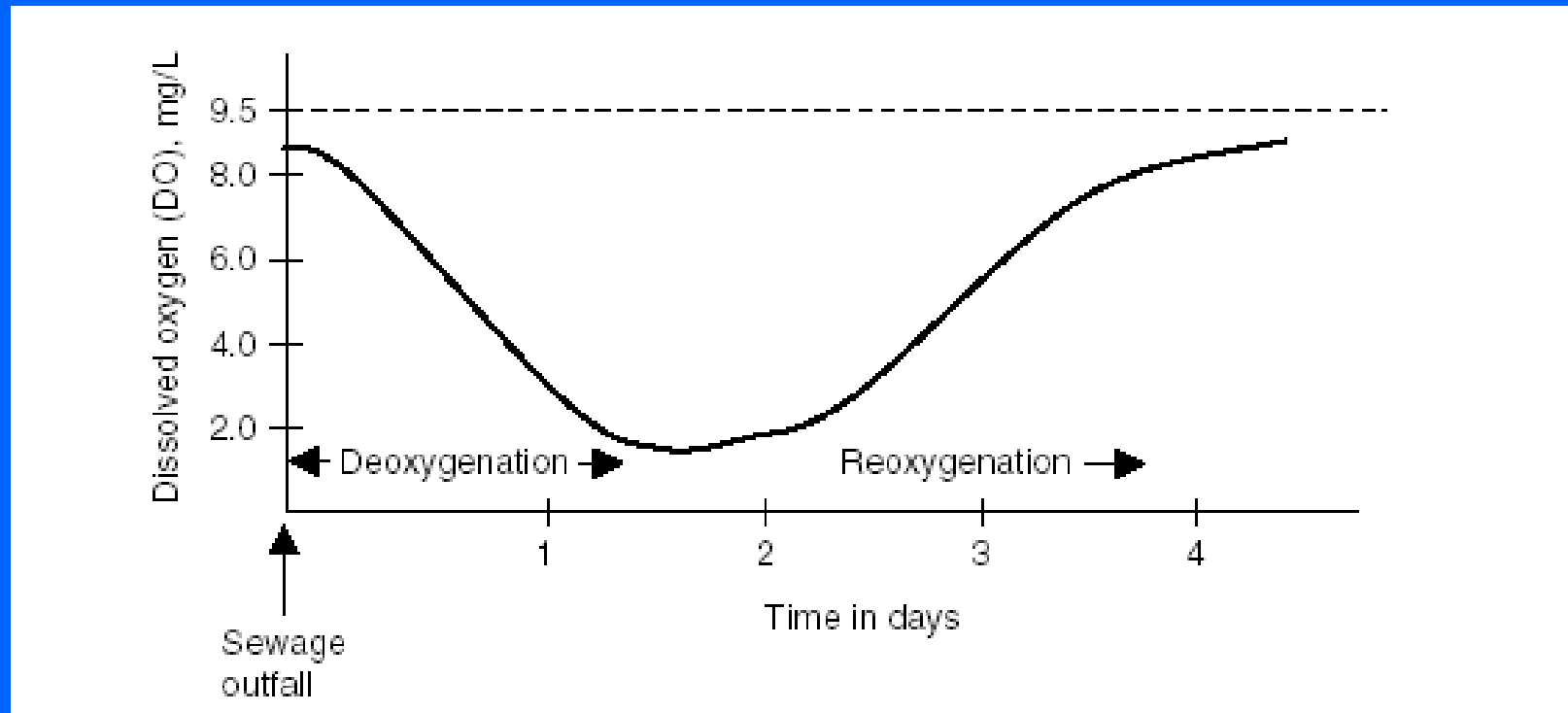
## HOW TO MANAGE WASTEWATERS IN COASTAL AREAS

- The management of wastewaters in coastal areas requires special attention because of the strict interconnection with the fragile ecosystem that results threatened by the several human activities.
- Usually wastewaters, both treated and untreated, end up into the sea near the beaches where they can compromise the quality of aquatic ecosystem; .
- The most critical requirements for the discharged waters regard the presence of pathogenic agents (virus and bacteria), nutrient concentration (dangerous for the eutrophication ) and the organic carbon that can reduce the dissolved oxygen

## CRITERIA FOR A CORRECT MANAGEMENT OF WASTEWATERS IN COASTAL AREAS

- When wastewaters are discharged into the sea the following conditions have to be kept in mind:
  - Wastewaters directly discharged into the sea are more critical for the aquatic ecosystem if compared to the discharge of the same waters into a river having an efficient self purification capability;
  - Vulnerability of coastal environment and the balneal requirements require special attention;
  - Sewage systems in coastal cities are still combined and this requires to bypass the wastewaters directly into the sea without any treatment

## TYPICAL SELFDEPURATION CAPABILITY OF A RIVER



Purification requirements for waters to be discharged into the sea are most strict if compared with those discharged into a river.

*Fonte: Spellman, F.R., 1996, Stream Ecology & Self-Purification . Lancaster, PA: Technomic Publishing Company.*

## RIMINI PROVINCE: POTABLE AND WASTEWATER WATER DATA



- Inhabitants  
294.084
- Water volume produced:  
42.002.010 cm
- Network length:  
2.378 km
- Sewage length:  
1.729 km
- Number of waste water  
treatment plants 7
- Wastewater volume treated  
(year) : 44.676.614 mc.

## RIMINI: SEASONAL TOURISM



- Residential inhabitants:  
300.000
  - Tourist arrivals  
some millions
  - Population increase in  
summer:  
about 30%
- 
- Tourism bring money during summer but at the same time produces effects on the environment such as:
    - Increase in the traffic with consequences on air and acoustic pollution, congestion, parking problems, etc.
    - increase in the consumption of resources (water and energy) and in the production of wastewaters and solid wastes

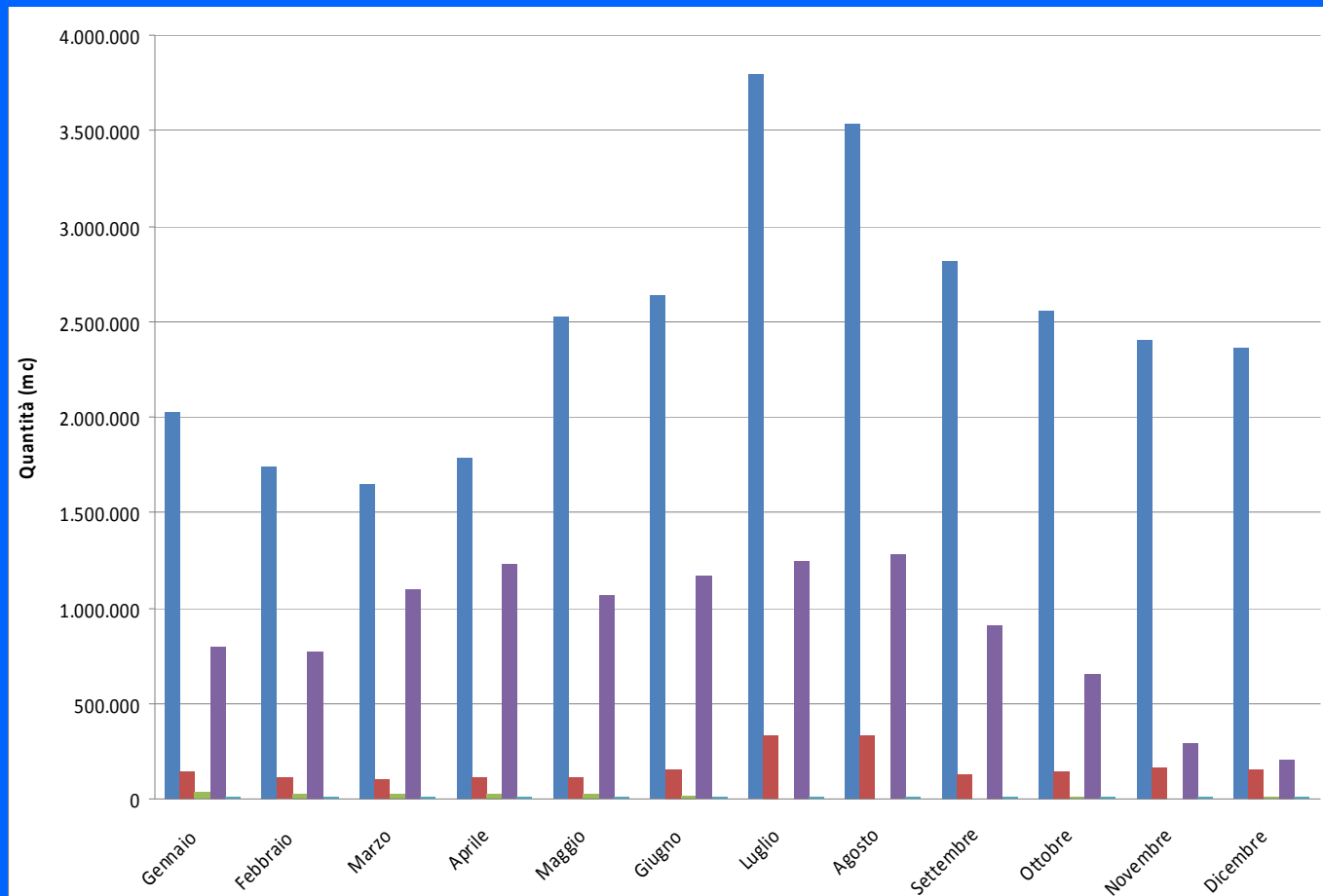
## RIMINI PROVINCE: THE SEVEN WASTEWATER TREATMENT PLANTS



Plant	Equivalent inhabitants	Treated Mm <sup>3</sup> /year
Santa Giustina	220.000	16,1
Marecchiese	270.000	12,3
Bellaria	70.000	2,59
Riccione	180.000	6,10
Cattolica	120.000	6,88
Coriano	12.000	0,293
Misano	40.000	0,457
TOTALE	912.000	44,7

*Fonte: Comunicazione Hera: depurazione delle acque urbane nel territorio di Hera rimini s.r.l* <http://www.gruppohera.it>

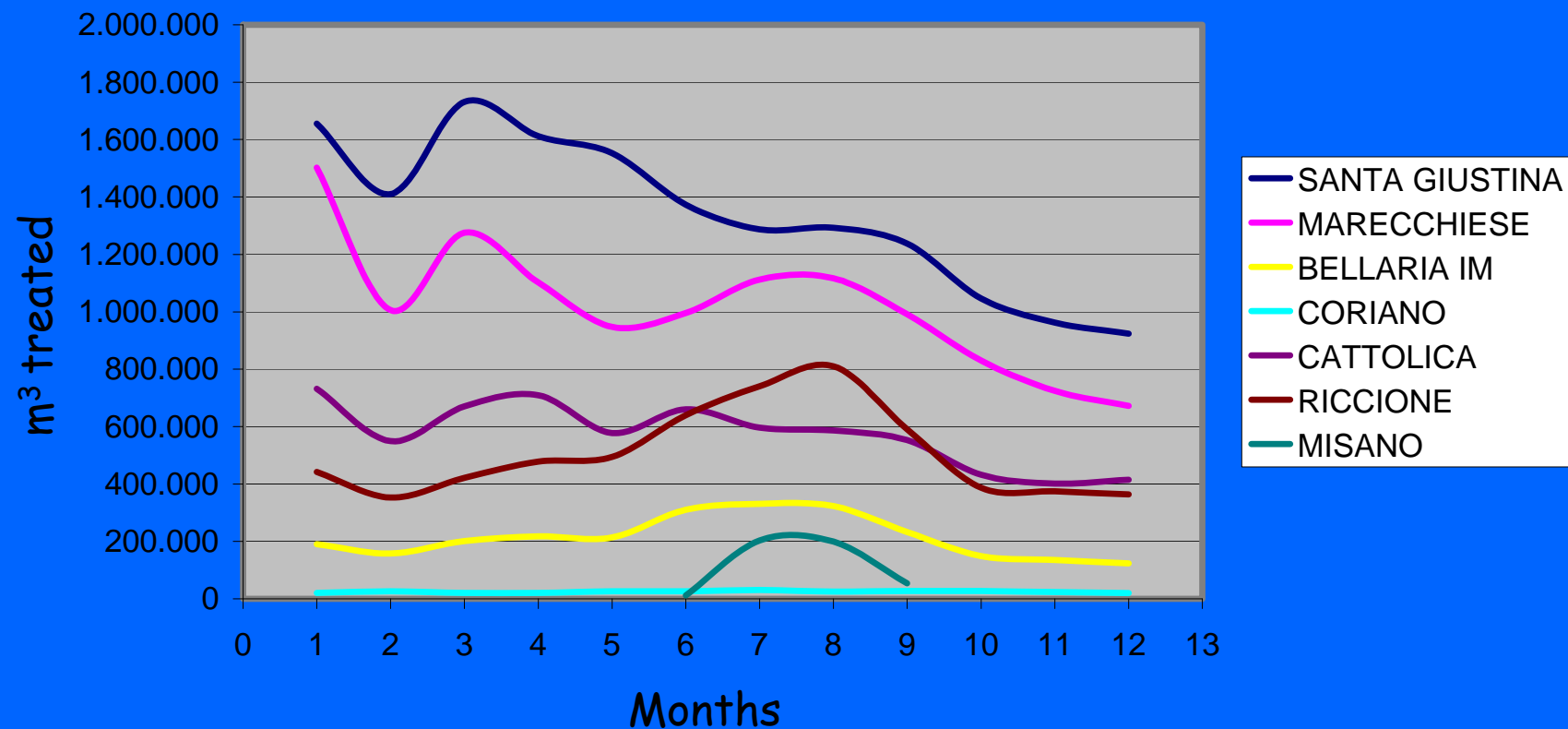
# POTABLE WATER SUPPLIED BY DIFFERENT SOURCES



*Fonte: Comunicazione Hera:  
depurazione delle acque  
urbane nel territorio di  
Hera rimini s.r.l  
<http://www.gruppohera.it>*

- Significant increase in the amount of water supplied during summer season.
- Increase of subsidence processes.
- Increase the amounts of wastewater treated

## TYPICAL EFFECTS OF SEASONAL TOURISM ON TREATMENT PERFORMANCE OF 7 PLANTS



*Fonte: Comunicazione Hera: depurazione delle acque urbane nel territorio di Hera rimini s.r.l/ <http://www.gruppohera.it>*

## THE POSSIBILITY TO RECOVER WASTEWATERS

- Much of the water we use ends up as waste water; waste water is produced when we use showers, toilets and machinery in our homes, shops, offices and factories;
- It is possible to collect and reuse waste water in our homes, offices, factories and farms as it can be treated to the standards required for agriculture, industry and even drinking.
- Waste water can be redirected prior to treatment, such as when shower water is directly re-used for flushing toilets, or after treatment, such as when treated sewage effluent is used for irrigating golf courses and orchards.

## BENEFITS OF RECYCLING WASTEWATER

- The main benefits of recycling waste water are:
  - that lesser quantities of potable water are used for purposes other than drinking; this lowers water supply costs, as potable water is expensive and limited, treatment costs and the need to build more dams
  - that storm water and sewage discharges are reduced, lowering the stress on streams, sewerage systems and storm water systems during wet weather.
  - that waste water used for irrigation undergoes natural treatment lowering the nutrient loads in waterways and reducing the pollution load in our rivers and oceans.

## CONCLUSIONS (I)

- The coast is an area of intense human activity. It hosts multiple physical, biological, social, cultural and economic processes in a state of a dynamic equilibrium.
- Conflicts may be generated in terms of renewable coastal resources (i.e. fish, freshwater) or non-renewable (i.e. land, oil and gas reserves, sensitive ecosystems).
- Impacts generated by major development projects or by a number of projects which may be individually insignificant have significant cumulative impact on the environment.
- The coastal area concentrates a wide range of economic activities. The main activities located on coastal areas are: settlements, tourism and recreation, industry, fisheries, energy production, transportation, agriculture and forestry.
- Coastal areas, confront acute problems that pose severe threats to coastal resources and furthermore to the viability of economic activities.

## CONCLUSIONS (II)

- The significance of the coastal areas is widely recognised as well as the need to act in the immediate future since pressure on this fragile environment is constantly intensifying.
- The uncontrolled and rapid land development coupled with land speculation has detrimental effects on the coastal environment.
- Overexploitation and consequent salinization of underground water aquifers is a common pattern throughout the Mediterranean Basin.
- The destruction of natural shoreline defences and the reduction of river sediment supply relate to rapid and extended urban development.
- Pollution is another critical problem. Lack of appropriate infrastructure has resulted to severe localised pollution problems.
- The above issues need to be considered in the broader socio-economic and institutional context of the area.

## CONCLUSIONS (III)

- Efficient application of legislative framework, right land-use planning and public participation in coastal areas management must be a priority when authorities define the water management policies.
- Public participation seems to be encouraged and sustained under the condition that it is legitimised and able to safeguard implementation of the outcomes of the adopted participatory approach.

