



**8th WORLD GENERAL ASSEMBLY OF  
THE INTERNATIONAL NETWORK OF BASIN  
ORGANIZATIONS**

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**From Headwaters to the Coastal Zone -  
Systemic Approach for Water  
Resources Management and  
Protection: a case study for the  
Itapicuru river basin, northeastern,  
Bahia - Brazil.**



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# PROPOSAL AIM

**This research presents the relevant guidelines that can be useful tools in the drafting of Basin Management and Action Plans.**

**This will highlight a systemic approach (GIS) integrating the physical, climatological, hydrological and socioeconomic characteristics of the Itapicuru River basin in the Bahia state – Brazil, to guiding planning programs of its water resources in a sustainable way.**

# GENERAL BACKGROUND

- ❑ About 11% of the arid lands of the world are in Brazil and 50% out of them are distributed around the basins of the Bahia state. There are around 6 million inhabitants dealing with the consequences.
- ❑ The territorial occupation in hydrographic basins is diverse and directly connected to the variety of climate and soil conditions, as well as the geo-economics ones.
- ❑ The flow regime of the fluvial system is pressured by the anthropogenic action, being subjected to inter-annual variability and long-term rainfall, which results in variations in the superficial drainage.
- ❑ The fragility of the coastal ecosystems are very dependent on the alterations in the flow and the quality of the tributaries waters along the basin.

# THE ITAPICURU RIVER BASIN - IRB

**AREA: 36,440 km<sup>2</sup>** (350 km down to the mouth)

**POPULATION: 1,300,000 inhabitants**

**Low demographic density (28 inah/km<sup>2</sup>)**

**THE GEOPHYSIOGRAPHICAL  
CONDICIONS IS DIVERSE AND THE  
ENVIRONMENTAL QUALITY IS  
COMPROMISED DUE: AGRICULTURAL  
AND CATTLE, MINING, INDUSTRIES,  
TOURISM, AND URBAN OCCUPATION  
WITHOUT PROPER SANITATION.**

**Volume of annual precipitation: 24,631.38 x  
10<sup>6</sup>m<sup>3</sup>; Total flow: 1,269.96 x 10<sup>6</sup>m<sup>3</sup>**

**The fluvial regime in the sectors is a reflex  
of the rainfall regional variation**

## Legend:

 Dams

 Localities

## Hidrography:

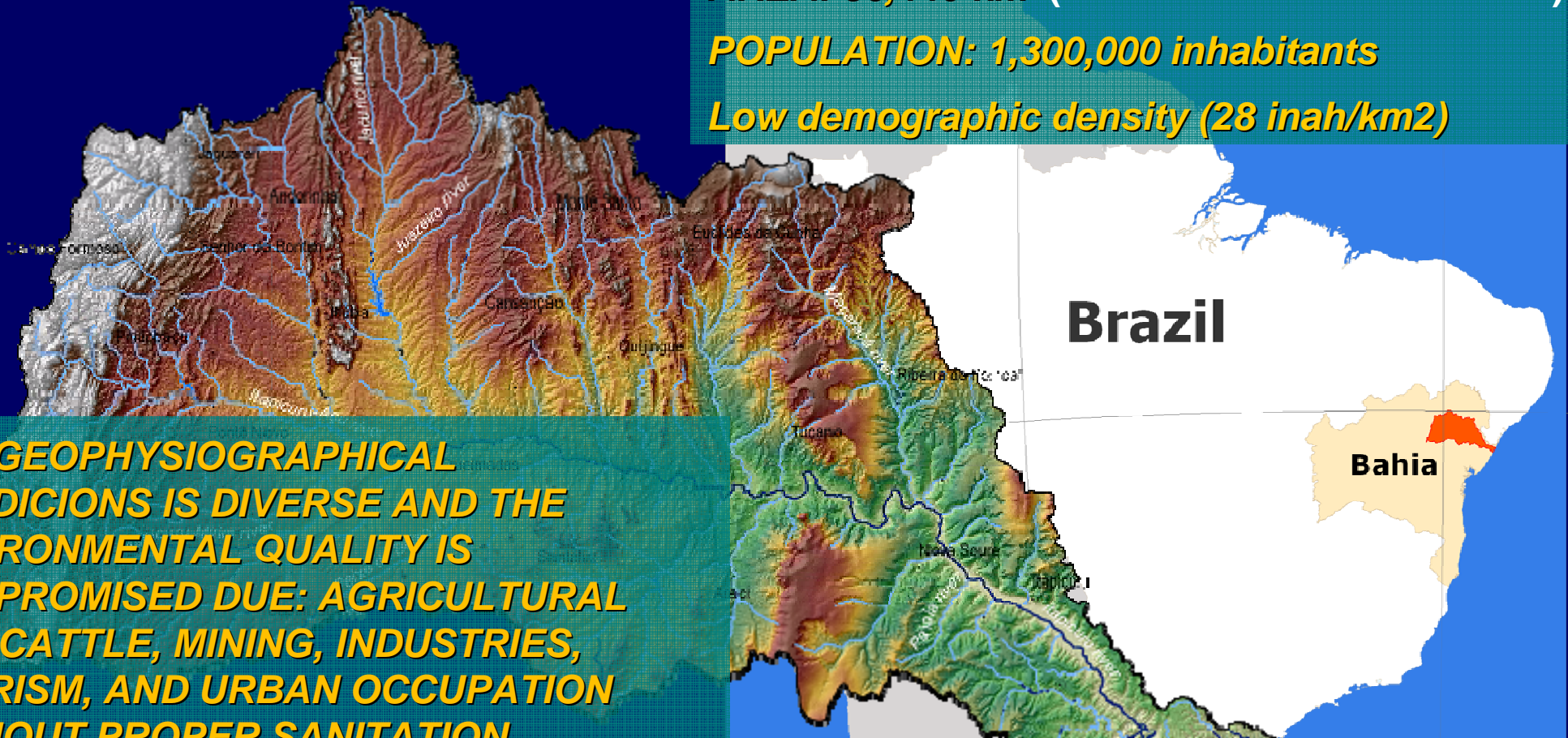
 Intermittent River

 Permanent River

## Digital Elevation Model

 1300 m

 0 m



10°S

30°S

30°S



# IRB : RAINFALL AND HYDROLOGICAL SECTORS

## Upper Sector (I)

727,6 mm

11,968.97 km<sup>2</sup>

## Middle Lower Sector (III)

682.27 mm

12,232.01 km<sup>2</sup>

## Lower Sector (IV)

1,182.7 mm

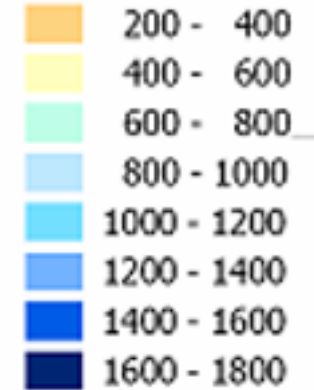
2,131.45 km<sup>2</sup>

## Middle Upper Sector (II)

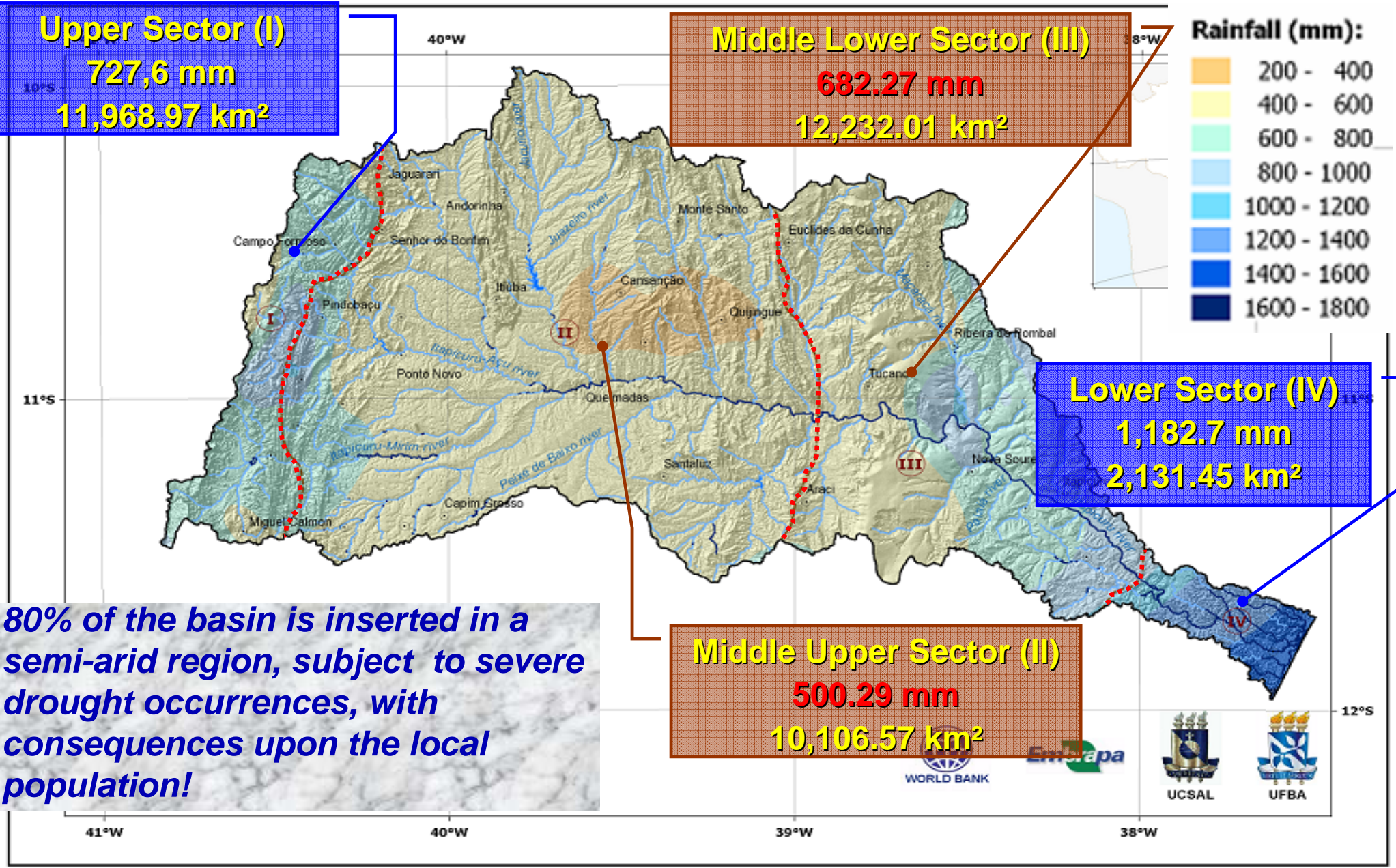
500.29 mm

10,106.57 km<sup>2</sup>

### Rainfall (mm):



*80% of the basin is inserted in a semi-arid region, subject to severe drought occurrences, with consequences upon the local population!*



Investigate the morphological evolution of the coastal plain and assessment of the restrictions environmental

An actual environmental diagnosis and prognostic of the basin associated to the water quality resources

Apply a innovative systemic approach integrating the analysis basin from the headwaters to the coastal zone

**ADAPTING TO THE CONSEQUENCES OF CLIMATE DIVERSITY AND CHANGE IN THE BASIN, FOR WATER RESOURCES MANAGEMENT AND PROTECTION**

Orientate and promote the planning of the territorial occupation and sustainable socioeconomic development of the water resources

**GUIDELINES**

# ACTIONS AND ACTIVITIES

**1 - Preliminary analysis of the environmental scenario, demand and water availability, and socioeconomic aspects**

- Secondary data
- exploratory visits at the basin

**2 - Evaluation of the surface water quality in regional scale**

- Water and sediment samples are evaluated in the study points, during the hydrological year. Are determinate Water Quality (WQI) and Trophic State (TSI) Indexes and the level NOAA of the metals in the sediments

**3 - Integrated and systemic analysis for an environment diagnosis and prognostic of the basin associated to the water resources quality**

- The databases is organized and structured into a GIS, in a regional scale
- In the systemic analysis are integrate: the physical vulnerability of the territory; the indicators related to the environment, productive activities and water quality; and the level of anthropogenic pressure

**4 - Evolution of the coastal plain associated to the river's mouth, identifying the geological risks and its environmental implications (1:25,000)**

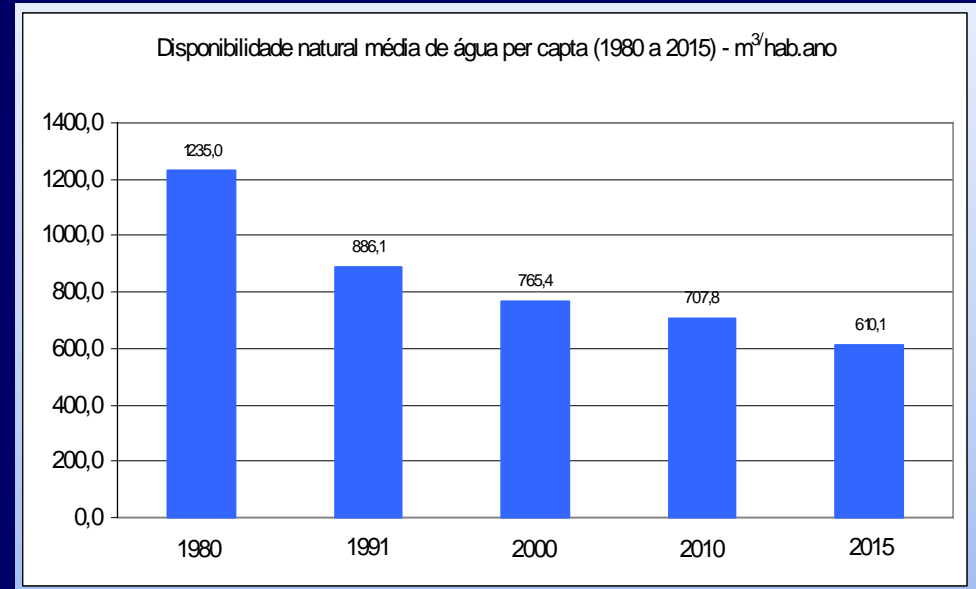
- A detailed mapping is performed integrating GIS, numeric model of the terrain, aerial photographs, Landsat, Cbers and Ikonos images, and field observations. An evolutionary model of the coastal plain is presented in detail

**5 - Products socialization**

- The products are available on DVD, with a Digital Atlas and the GIS of the basin and coastal region

# DEMAND AND WATER AVAILABILITY

The natural availability average, from the flow at the mouth, has decreased 10% to 12% per year, in the last 20 years. With the growth of the population may also decrease in the next 5 years.



The average water natural availability per capita at the Itapicuru

<b>Data</b>	<b>1980</b>	<b>1991</b>	<b>2000</b>	<b>2010</b>	<b>2015</b>
Population (inhab)	963,652	1,186,331	1,232,480	1,277,929	1,304,691
Flow (m <sup>3</sup> /s)	37.7	33.3	29.9	28,7	25.2
<u>Average per capita</u> (m <sup>3</sup> /inhab.year)	1,235.0	886.1	765.4	707.8	610.1



# PHYSICAL VULNERABILITY (PV) ASSOCIATED TO THE POPULATION AND WATER RIGHT GRANTS

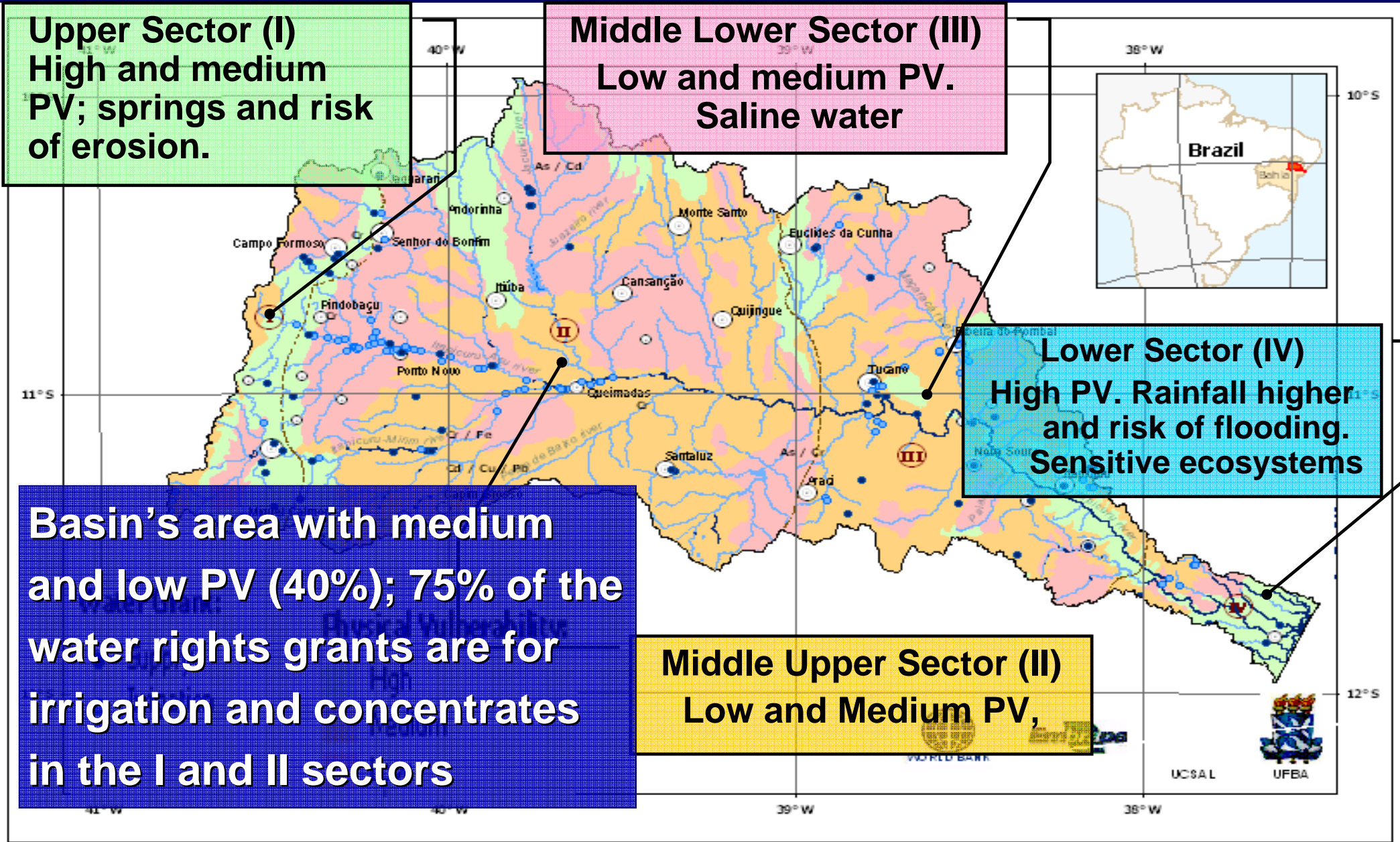
**Upper Sector (I)**  
High and medium PV; springs and risk of erosion.

**Middle Lower Sector (III)**  
Low and medium PV.  
Saline water

**Lower Sector (IV)**  
High PV. Rainfall higher and risk of flooding.  
Sensitive ecosystems

**Basin's area with medium and low PV (40%); 75% of the water rights grants are for irrigation and concentrates in the I and II sectors**

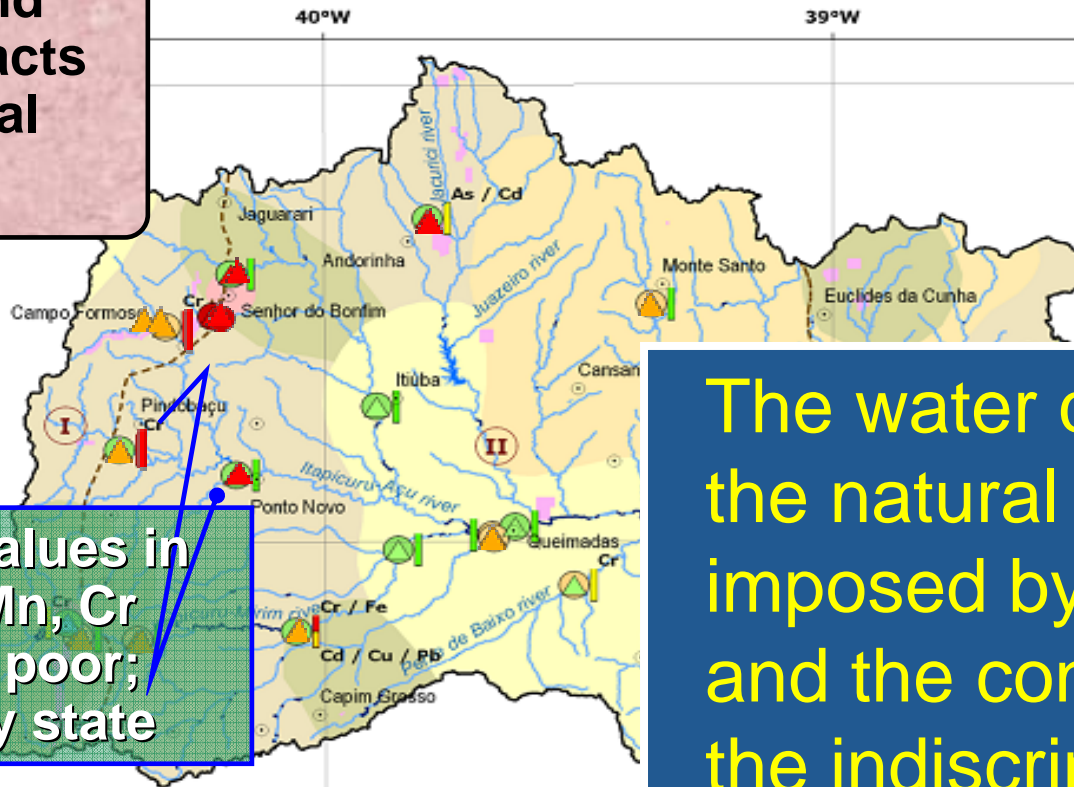
**Middle Upper Sector (II)**  
Low and Medium PV,



# THE SOCIOECONOMIC UNITS ASSOCIATED TO THE WATER QUALITY

The mining and urban impacts are punctual

The low economic dynamism is predominant over the basin



The highest values in the water: Mn, Cr and P; WQI poor; hypertrophy state

The water quality reflects the natural conditions imposed by the semi-arid and the consequences of the indiscriminate use of the land, such as: salting; eutrophication and punctual chemical contamination.

- Legend:**
- Dams
  - Localities
  - Hidrograf**
    - Intern
    - Perma
  - Socio-economic Units**
    - Regional Urban Centers
    - Mining
    - Livestock
    - Temporary Agriculture
    - Permanent Agriculture
    - Low Dynamism

Eutrophy / mesotrophy  
 TSI and good WQI  
 over the river courses  
 associated to the  
 agriculture and  
 sewers

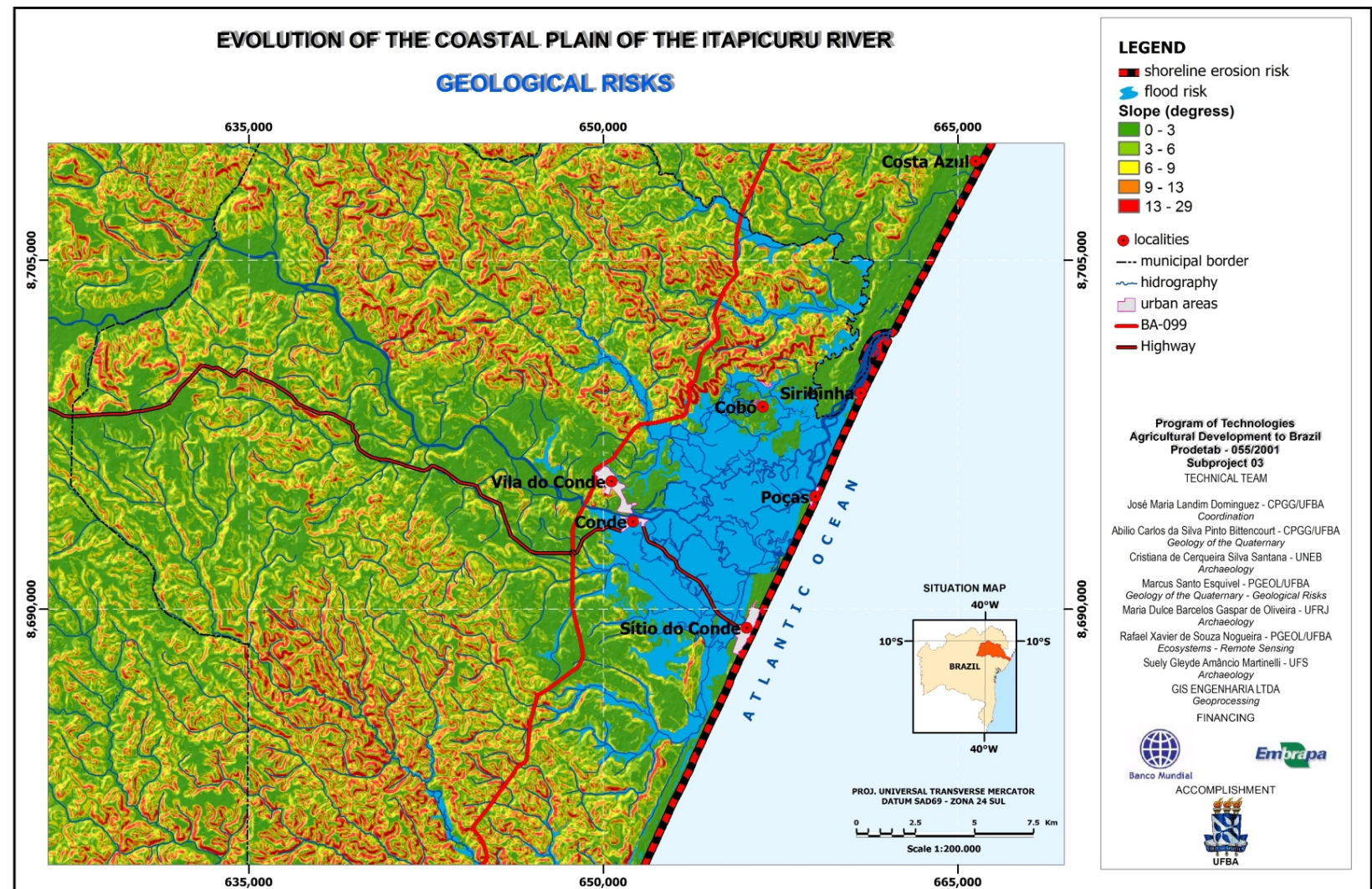
▲ Oligotrophy



# The environmental restrictions related to the geological risks of the coastal plain associated to the mouth

The map guides the use and soil occupation directives and the coastal management programs.

The tourism in the region should be approached with great caution, respect to the restrictions posed by geological risks



# CONCLUDING REMARKS

- In general, the quality of the natural resources in the basin is good. However the economy is stagnated and the poverty rates are high; Low dynamism and poor areas are predominant...
- The landscape units indicates areas for the productive activities that are compatible with the environmental fragilities and climate;
- The methodological approach is innovative for large basins and aggregates numberless information for the region planners and investors;

**The management of the water resources in the hydrografic basin depends of the proper scientific knowledge of its different parts and those ecosystems and by the adoption of a systemic and integrated approach, in order to adapting the managemet to the consequences of climate change in the basins.**





**THANK YOU! GRACIAS!  
MERCÍ!**

*This research integrates the Investigation Project PRODETAB/EMBRAPA: “Contribution to an integrated plan for the use and conservation of water resources in the Itapicuru river basin, State of Bahia, Brazil”*

