



IV International Symposium on Transboundary Waters Management

# DELINEATION OF WATER RESOURCES REGIONS TO PROMOTE IWRM AND FACILITATE TRANSBOUNDARY WATER CONFLICTS RESOLUTION

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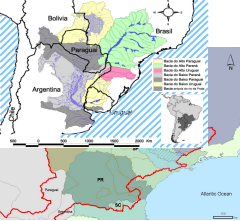
*Rodrigo MAIA*



# CONTENTS



- Introduction
- Comparative Analysis
- Next Steps
- Conclusions



# PROBLEM ADDRESSED

- **Existence of conflicting water resources regions for planning and management**
  - Region: **geographic territory**
  - River basin limits are **accepted** geographic regions
  - Watershed can be delineated from **any point** in a stream
  - Consider other **relevant aspects** (subjective process)
  - E.g. **political boundaries** (generally not coincident)
  - Reflect multiple interests, not only **established sectors**
  - **Need Integrated** Water Resources Management

# SOLUTION PROPOSED

- **Development of a Decision Support System to help the evaluation of ill-structured problem**
  - Establish some technical/scientific **reference**
  - Incorporate multiple stakeholders and **multiple criteria**
  - Define the **Algorithm** that represents the problem
  - Techniques Used:
    - Expert Systems and Knowledge-Rule Systems
    - Multi-Criteria Decision Analysis (MCDA)
    - Geographic Information Systems (GIS)
    - Compromise Programming and Cluster Analysis

# THREE PHASES



- **PHASE 1:** Understand the important aspects related to the delineation of water resources regions
- **PHASE 2:** Build the Decision Support System
- **PHASE 3:** Validate the system

# PHASE 1

- Conceptualize the problem
- **Compare** the models adopted in different countries:
  - Outline relevant regions for IWRM
  - Include existing Institutional Framework
- Understand and represent the related **knowledge rules**
- Recognize the **heuristic knowledge** related to the decision-making process
- **Select** the criteria to be **incorporated** into the Expert System

# SELECTED COUNTRIES

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## Europe:

- England
- Germany
- Netherlands
- Greece
- France
- Denmark
- Spain
- Portugal

## Americas:

- United States
- Colombia
- Mexico
- Brazil

# SUMMARIZED ASPECTS



COUNTRIES	PORTUGAL	SPAIN	GREECE	UNITED KINGDOM	NETHERLANDS	GERMANY	FRANCE	DENMARK	UNITED STATES	COLOMBIA	MEXICO	BRAZIL
<i>Form / System of Government</i>	Unitary Republic Parliamentary	Unitary Monarchy Parliamentary	Unitary Republic Parliamentary	Unitary Monarchy Parliamentary	Unitary Monarchy Parliamentary	Federalism Republic Parliamentary	Unitary Republic Executive & Parliamentary	Unitary Monarchy Parliamentary	Federalism Republic Executive	Unitary Republic Executive	Federalism Republic Executive	Federalism Republic Executive
<i>Water Resources Regions</i>	10 River Basin Districts Under WED	14 River Basin Districts Under WED, including	14 River Basin Districts Under WED	17 River Basin Districts Under WED	4 River Basin Districts Under WED	10 River Basin Districts Under WED	12 River Basin Districts Under WED	4 River Basin Districts Under WED (probably)	21 Regions and 222 Subregions	33 CARs - Reg. Environmental Authorities	13 Administrative Basins Limited	12 National Hydrographic Regions Limited
<i>Purposes</i>	Mainly Planning	Mainly Planning	Mainly Planning	Mainly Planning	Mainly Planning	Mainly Planning	Planning: SDAGE Administrative Unit + Hydrography	Mainly Planning	Data Management Political + Cultural + Jurisdiction	Management and Planning Biogeography, Hydro-geographic and Geopolitical	Management	Planning
<i>Criteria considering when delineating those regions</i>	Hydrography	Hydrography	Hydrography + Hydrogeology	Hydrography	Hydrography	Hydrography + Ecoregions	Hydrography + Ecoregions	Hydrography	Hydrography + Political + Cultural + Jurisdiction	Hydrography + Biogeography, Hydro-geographic and Geopolitical	Hydrography	Hydrography
<i>Other Established Regions</i>	5 Hydrographic Regions Administrations	10 Hydrographic Confederations	13 Reginal Water Directorates	129 CAMs and 8 Regions	65 Water Boards	Working groups of State Water authorities	Local Water Commision	-	Interstate Compacts + Commissions	-	102 sub-regions	Federal and State Water Resources Units
<i>Purposes</i>	Planning	Planning and Management	Management	Management	Management	Planning	Planning and management	-	Reference	-	Regional Planning	Planning and Management
<i>Criteria</i>	Political Aspects ?	Hydrography and ?	Administrative Regions	Surface Water Catchments	Geographical + Hydrological	Hydrography	Small river basins	-	Hydrography	-	Political jurisdictions	Hydrology + socio-political
<i>Committees</i>	-	Water Council	Regional Water Committees	CAMs are Committes?	Water Boards are Committes?	International River Basin Organizations	River Basin Authorities	County and Municipal Councils	Watershed Groups	Regional Boards of CARs	25 River Basin Councils	River Basin Committees
<i>Public Participation</i>	-	Yes.	Yes.	Yes.	Yes.	Yes.	Limited.	?	Limited.	Yes.	Limited.	Yes.
<i>Real Planning and/or Management at River Basin Level</i>	Yes. Legally binding river basin plans. Management?	Yes. Competent Water Authorities.	No. Carried out along administrative boundaries.	Yes? Management in CAMs ? Planning?	Yes. Competent Water Authorities.	No. Water P&M is performed by regional authorities.	Yes. Competent Water Authorities.	No. Water P&M is performed by Counties.	No. Water P&M is conducted by State level.	Yes. Competent Water Authorities?	No. Water P&M still centralized by CONAGUA.	Maybe. State and Federal Intervention Exists.
<i>International River Basin Commissions</i>	Bilateral Agreements with Spain at Mino-Lima, Duero, Guadiana, Tagus.	Bilateral Agreements with Spain at Mino-Lima, Duero, Guadiana, Tagus.	Bilateral Agreements: Aaos, Vardar/Axios, Strimon, Marits/Evros, Prespa.	England-Wales cross-border arrangement. Foyle/Erne/Melv in & Neagh/ Bann/Dundalk with Ireland.	International Commission for the Protection of the Rhine + Meuse, Shelde and Ems Commissions	Intern. Comm. for the Protec. of the Rhine; of the Elbe; of the Danube + Meuse, Ems, Oder Commis.	Schelde, Meuse and Rhone Commissions	None	Rio Grande Mexico + ?	?	Rio Grande, USA + ?	Bilateral Agreements at La Plata and Amazonas River Basins



# PHASE 1 - RESULTS



- Promote necessary **understanding** about **IWRM regions**
- Work towards a **theoretical analysis** of existent experiences
  
- **Many examples** of conflicts in water resources regions
- **Initial Focus:** Europe and Americas
- May include **some other examples** in the future

**Next step:** interview/surveys with **Expert Decision Makers** (refinement)

# INTERVIEW / SURVEY

<p><b>Water Resources Planning and Management Regions</b>  <b>Delineation Process and Aspects Considered</b></p> <p>Developed by Ana Carolina Coelho          Ph.D. Candidate at Colorado State University          As part of current research project (ongoing)</p> <p><b>COUNTRY NAME</b></p> <p><b>Who is answering?</b>          Name          Institution:          Address:          E-mail:          Phone:</p> <p><b>Government Characteristics</b>          What is the form and system of Government?</p> <p>Any comments regarding the form and system of Government that may interfere with Water Resources Planning and Management?</p> <p><b>Water Resources Regions</b>          Are there water resources regions delineated for the whole country area?</p> <p>Are there more than one level or more than one division for the country?</p> <p>Level/Division 01:          How many?</p> <p>What are the main purposes of those regions (e.g. Planning, Management, Data Management, etc.)?</p> <p>Which criteria was considered when delineating those regions (e.g. River Basin Limits, Political Subdivision, Administrative Regions, Cultural, etc.)?</p>
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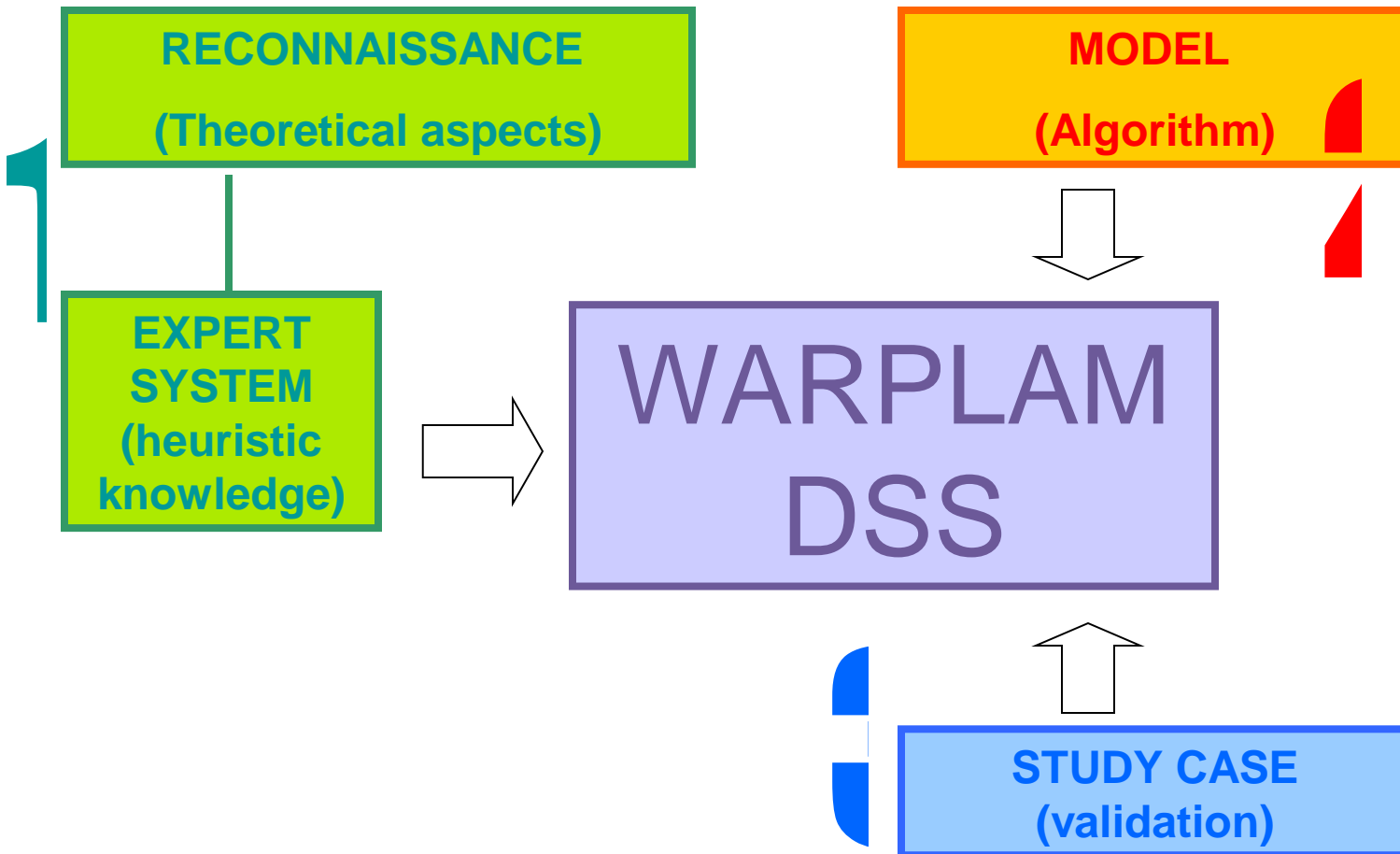
# PHASE 2 - DSS

- **Model** the problem (parameters)
- Build the **Algorithm**
- **Incorporate** criteria from the **Expert System**
- Define the **measure of closeness** by overlaying areas, using GIS and MCDA
- Standardize space dimensions using CP
- **Merge units into regions**, using Cluster Analysis
- Evaluate Fuzzy Logic and DP to improve the algorithm

# PHASE 3

- **Validate** the Model
- Use a representative **study case**: Brazil
- Consider the size differences of “river basin areas”
- Address **conflicts** in **water resources regions**:
  - Rivers under dual domains (water property rights)
  - Extreme proliferation of river basin committees
  - Twelve national hydrographic regions  
(inappropriate scale for planning and management)
- **Suggest** standard and harmonized regions

# PRELIMINARY DESIGN



# WARPLAM DSS

- **Users:** International Commissions, National Councils, etc.
- **Addresses** the problem in real world situations
- Includes human intuition and judgment
- Constitutes a **learning process**
- Provide flexibility to include new aspects
- Increase quality of **future decision-making** processes
- **Lessen political boundary effects** (internal and external)
- Key to reduce **transboundary conflicts**

**Current technology in the past:** would the political limits be different, maybe based on river basin limits?