Tropical Agriculture and Water Resources

Challenges in Science and Technology and Opportunities for International Cooperation

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International IAP Symposium: Enhancing Water Management Capacity in a Changing World

Session 2- More with Less: Managing Water for Agriculture

Memorial America Latina,SP, Brazil, June 25th, 2012

Exploration of Water Resources

- **Importance of Water Resources and Agriculture**

- Out of 1,5 billion hectars cultivated worldwide

about 270 millions are under irrigation (18% of the total)

- Half of the world food production is under irrigation

- Índia e China ("overpumping")

  World Bank: 175 mi indians and 130 mi chineses depend on grains produced through over pumping water from the ground water. This leads to a "buble" of food production. It will blow up by the time ground water is depleted.

Exploration of Water Resources in Brazil

- **Brasil has 12% of the surface water of the planet**
- Brazilian Water Agency - Water Resources Report Brasil 2011

- Total Withdraw (1.841,5 cubic meter/second)

- 47% Irrigation
- 26% Urban Use
- 17% Industrial Use
- 8% Animal Use
- 2% Rural Population

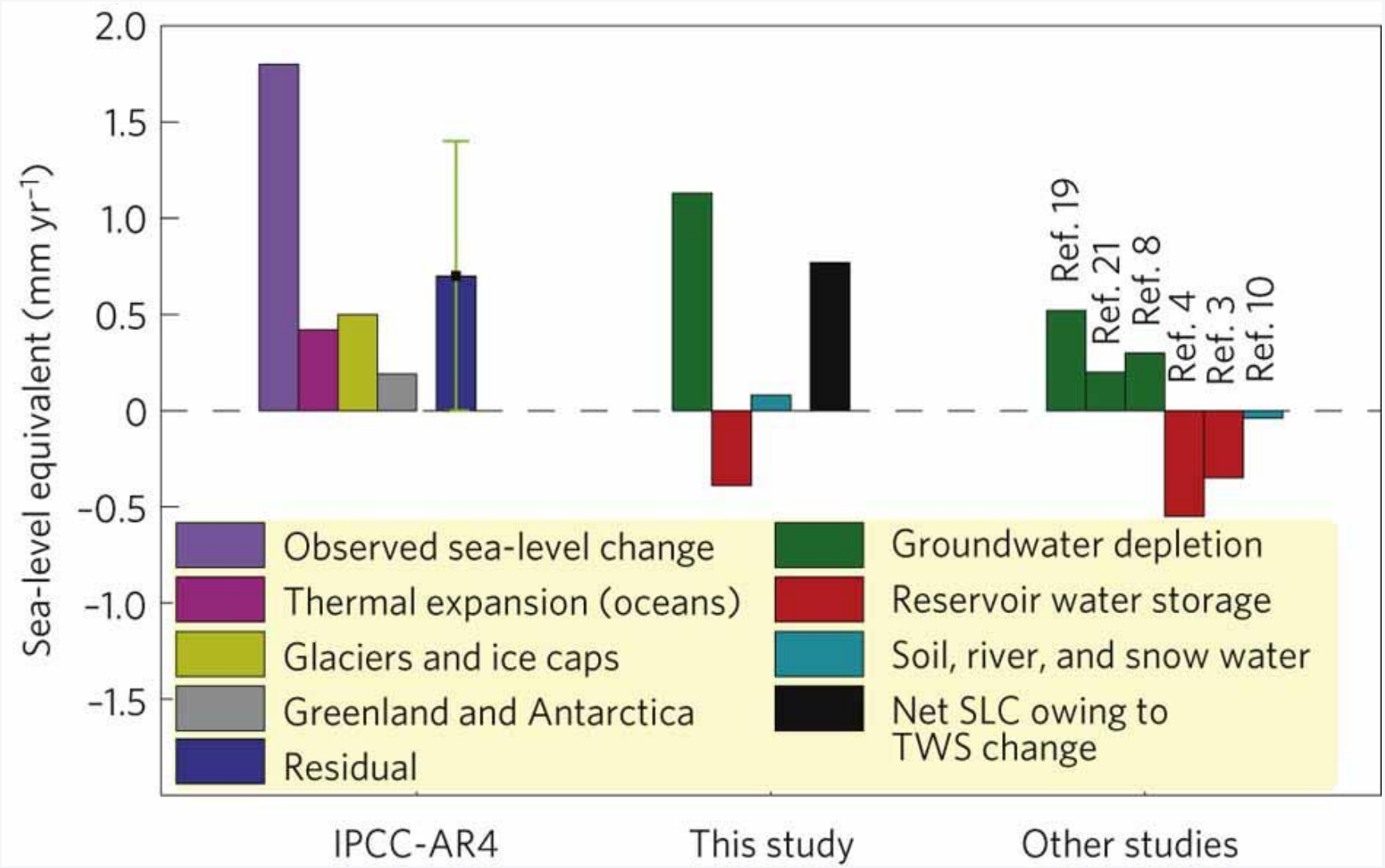
- Total Consumption (986,4 cubic meters/second)
- 69% Irrigation
- 12% Animal Use
- 10% Urban Use
- 7% Industrial Use
- 2% Rural Population

- *83% consumption is in the rural area!*

- About 4.6 mi hectars are irrigated. Potential is of 29.6 mi hectars.

From Pokhrel et al, 2012 (*Nature Geoscience, vol 5, pgs 389-392)*

Figure 2:Estimates of various contributions to the observed SLC.



Brazilian Science and Technology
in Agricultural Research

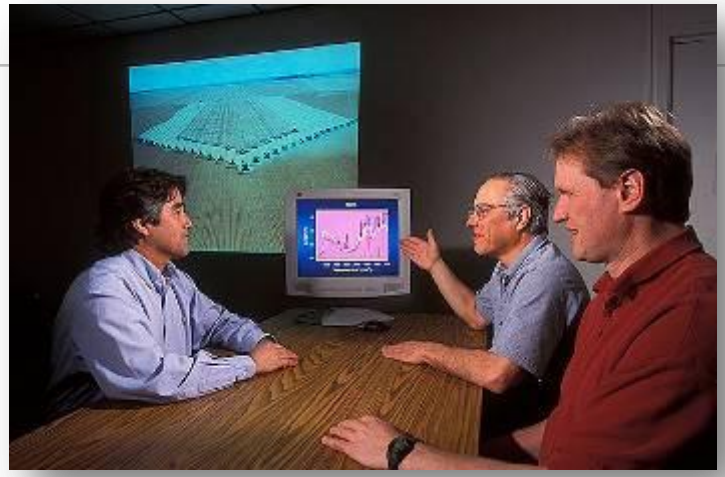
NARS - National Agricultural Research System

- Privately held company
- 17 Public Agricultural Research Organizations
- Public Research Institutions
- Public Universities
- Private Universities
- Funding agencies (CNPq, Finep, Capes, FAPs…)
- **Embrapa –** Brazilian Corporation for Agriculture Research

Total Investment in S&T: 1.1-1.3% of GDP

Source: Ministry of Science and Technology and CNPq.

Embrapa



Mission

To design solutions that enable the research, development and innovation to the sustainable agriculture so that to benefit the Brazilian society.

Institutional Profile

- Established in **1973**
- **9,506** employees
- **2,355** researchers
- **2,061** PhD researchers
- **47** Research Centers and Services
- International Cooperation: Americas, Europe, Asia and Africa
- Yearly Budget: **US$ 1 billion**

International Cooperation

International Partnership

- Bilateral agreements: **78**
- Countries: **56**
- Institution: **89**
- Multilateral agreements: **20**

Scientific Cooperation

- ***Labex United States:***……..USA
- ***Labex Europe:***…… France and United Kingdom
- ***Labex Korea:***……..South Korea
- ***Labex China:***……..China
- ***Labex Japan:***……..Japan

Technical Cooperation

- ***Embrapa Africa :*** TT Projects (Ghana, Mozambique, Mali, Senegal)
- ***Embrapa Americas :*** TT Projects (Panama and Venezuela)

Tropical Agriculture

Achievements and contributions of Embrapa and NARS

- Fibers and wood (Cotton, *Eucalyptus*)
- Tropical grasses (*Brachiaria*)
- Biotechnology
- Agriculture in the Cerrado
- Biological pest control
- Nitrogen fixation
- No-tillage system
- Animals and plants under tropical conditions
- Tropical and temperate horticulture
- Zebu cattle
- Aviculture
- Soybean production (Photoperiodism)
- Integrated Crop-Livestock-Forest-Systems (ICLFS)

Brazilian Agriculture

Brazil's annual agricultural production (millions of tons)



Grain **145**



Meat **25**



Fruit **41**

Contribution of Agriculture

28% GDP

37% Labour

42% Exports

Brazil

- 3rd largest world exporter: US$ 64,8 billions
- Largest world exporter of coffee, sugarcane, orange and ethanol

Source: IBGE, Conab and MDIC.

Brazilian Agriculture

Contribution of Family Farming



Photo: Cláudio Morães

- Farming area: **106.8** million hectares
- **12** million producers (1/3 of them are women)
- **24%** of agricultural area
- **84%** of land owners in Brazil

- Cassava..... **87%**
- Milk..... **58%**
- Bean..... **70%**
- Cattle..... **30%**
- Poultry..... **50%**
- Corn..... **46%**
- Swine..... **59%**
- Rice..... **34%**

Source: Ministry of Agrarian Development

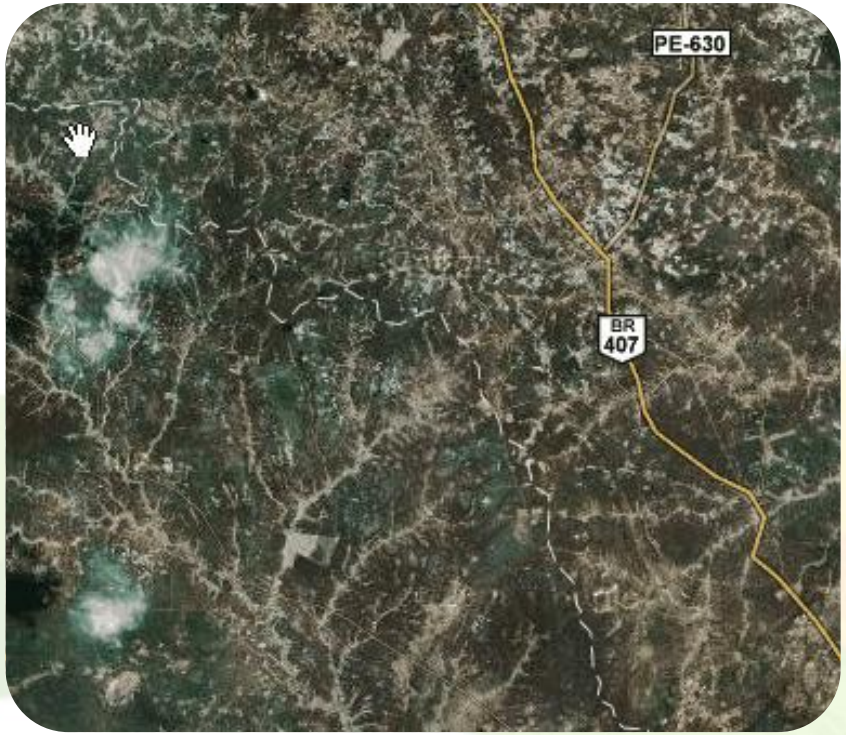
No-tillage System



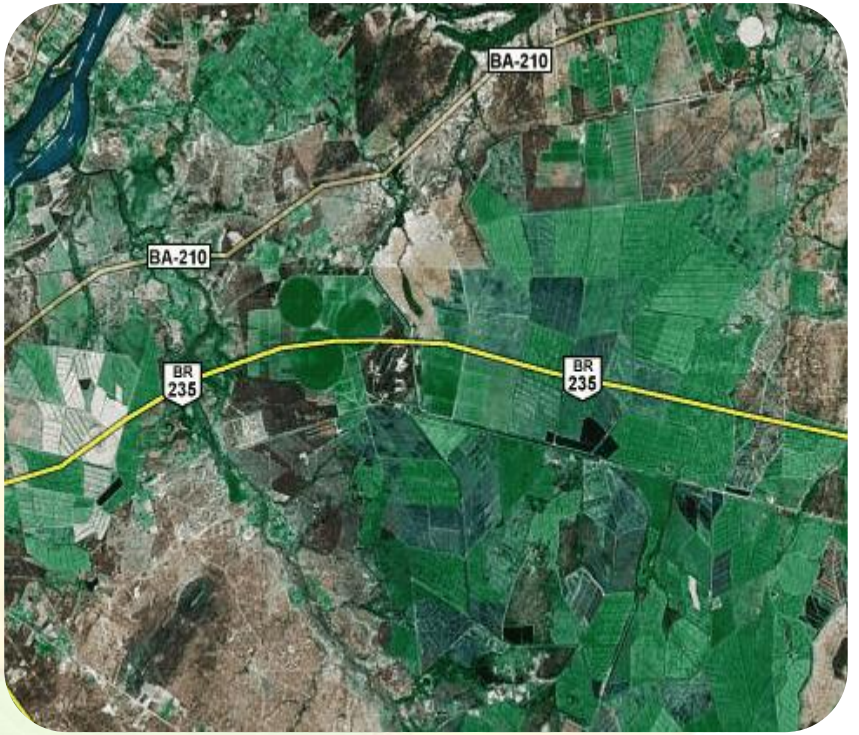
Integrated Crop-Livestock-Forest-Systems



A Green Technological Revolution!



The semi-arid region was like this.



Today, it changed to that!

Environmental Studies of Agricultural Interest and Vice-Versa

- Catchment as the Management Unity

  Subsidize Public Policies, Characterization, Integrated Studies and Management of Terrestrial and Aquatic Ecosystems, Production Systems, Impact and Remediation of Agricultural Activities

- Balances of Mass and Energy
- Concept and application of Gauged and Ungauged Catchments
- Simulation and Modelling
- Use of Models such as USLE, SWAT and Clue-S
- Prediction of Soil Loss, Run-off and Leaching of Agricultural Inputs
- Case Studies of Land Use Change and Environmental Impacts

São Carlos County and Neighborhood



MBH-Guabirobas





Minoti, R. T, 2006







MBH-Guabirobas











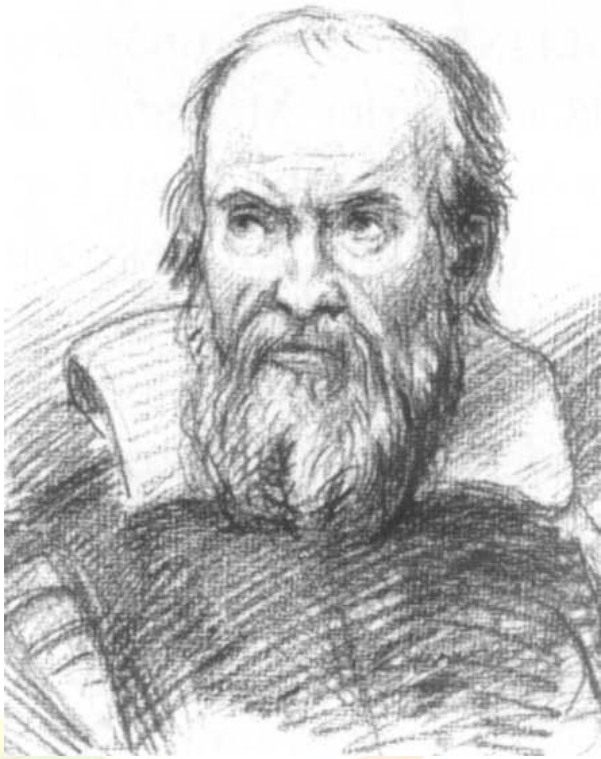




Minoti, R. T, 2006

About water science...

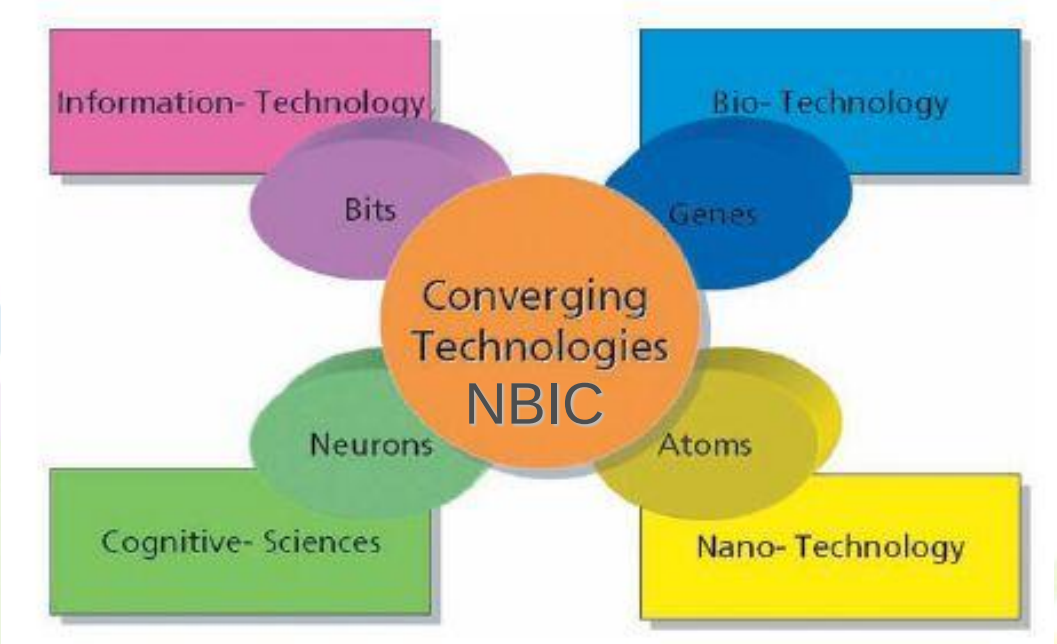
"I had less difficulty in the discovery of motion of heavenly bodies in spite of their astonishing distances than in the investigation of the movement of ***water*** *before our very eyes"*

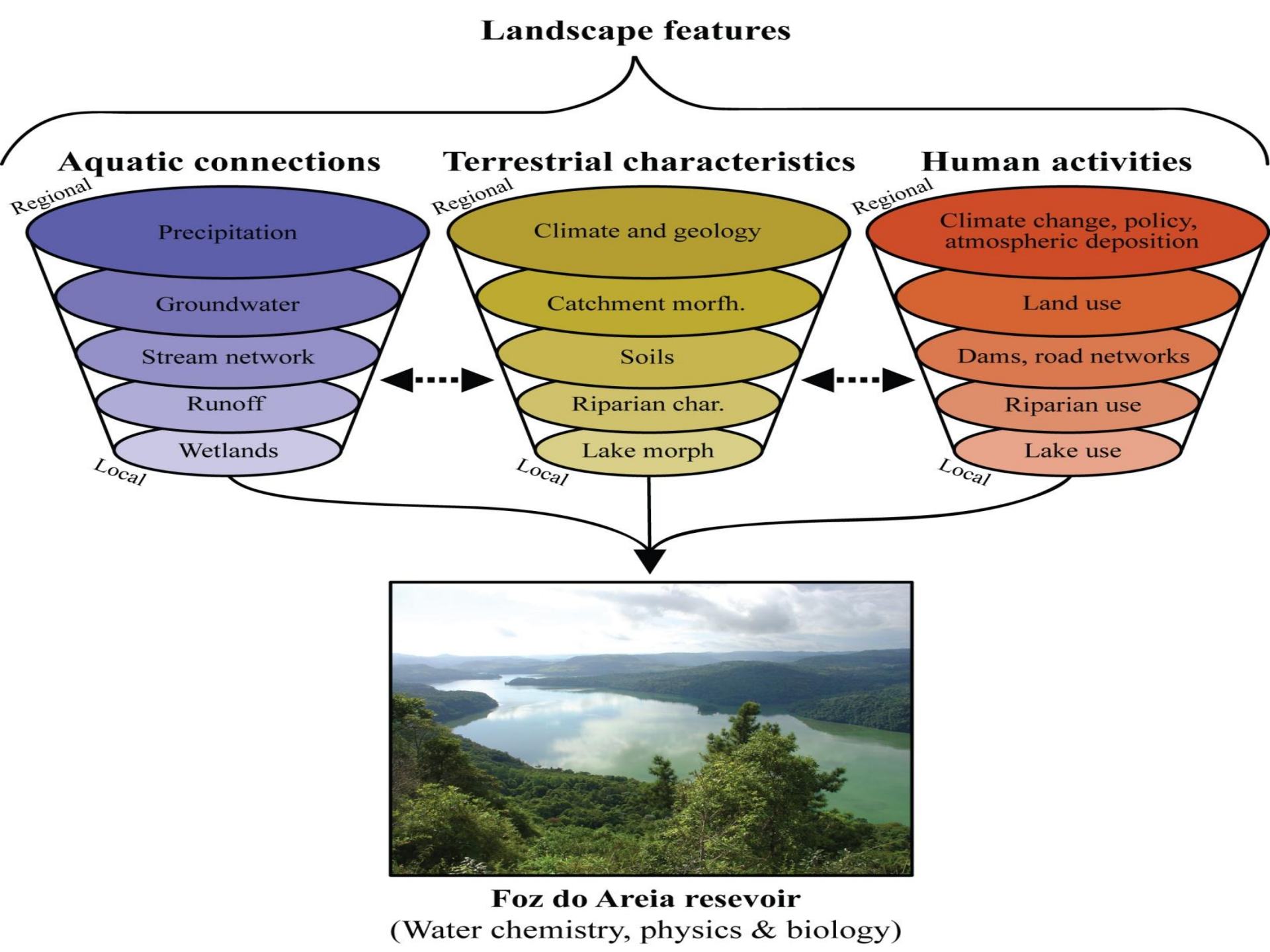


Galileo Galilei (1564-1642)

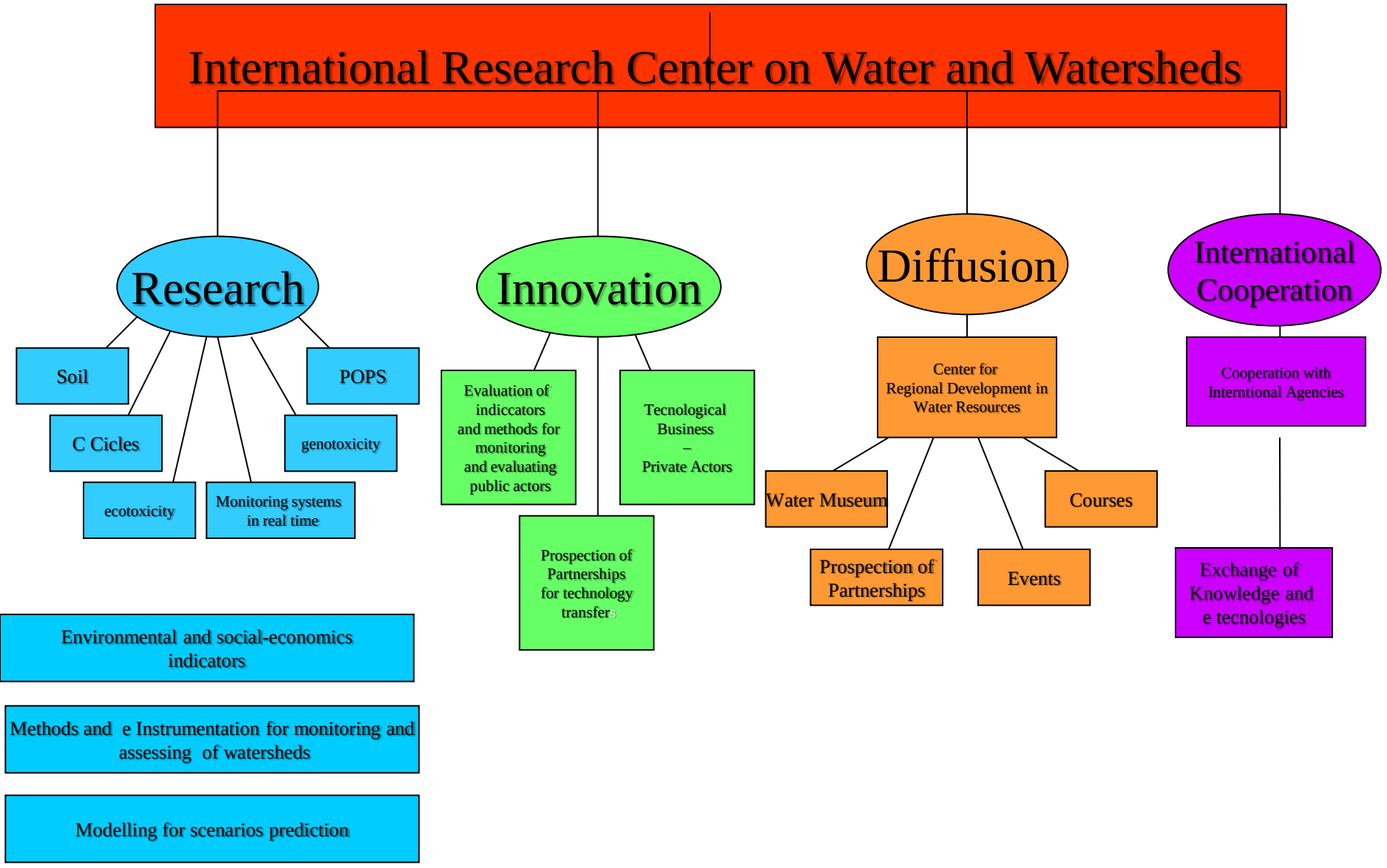
Converging Technologies

New Inter and Transdicisplinary Paradigms




Landscape features
Aquatic connections
Regional
Precipitation
Groundwater
Stream network
Runoff
Wetlands
Local
Terrestrial characteristics
Regional
Climate and geology
Catchment morfh.
Soils
Riparian char.
Lake morph
Local
Human activities
Regional
Climate change, policy, atmospheric deposition
Land use
Dams, road networks
Riparian use
Lake use
Local
Foz do Areia resevoir
(Water chemistry, physics & biology)

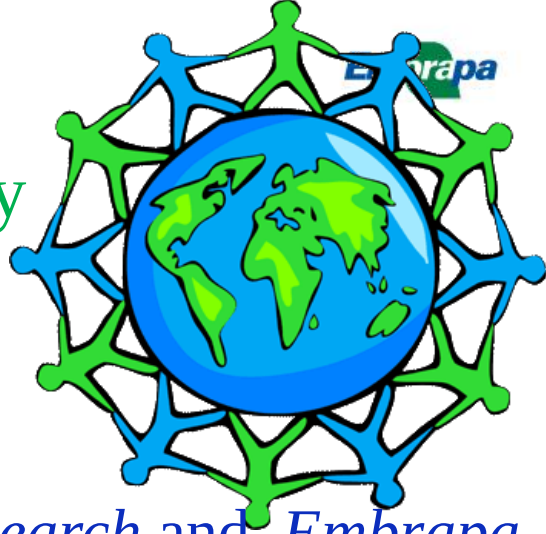
An integrated, interdisciplinary and multiinstitutional project proposal byTundisi et al, 2011...



Opportunities in Ag Science & Technology and International Cooperation

- Develop and Evaluate Sustainable Systems for recuperation of degraded areas, especially by livestock grazing
- Develop and Exploit second generation technologies
- Take a stand on water footprint: blue, green and grey water and Establish a Brazilian R, D & I network, water resources and agriculture
- Measure life cycle (water, energy, greenhouse gases, rate of loss or gain of biodiversity ...) of agricultural products
- Establish quality indicators, measure them and monitor them (the metrics of sustainability)
- Measure the vulnerability and resilience of agricultural systems
- Simulate and model agricultural systems seeking to establish scenarios and forecasts

Opportunities in Ag Science & Technology and International Cooperation



Establishment of partnership with :
International Center on Water and Watershed Research and *Embrapa Agricultural Instrumentation*, in São Carlos, SP for:

Development and use of instrumentation, methods, simulation and modelling like multifractal analysis, imaging techniques, sensors, precision farming, converging technologies and complex systems approach...

Calibration, sensitivity, modification and validation of the models in use

Evaluation of agricultural land use change and impacts on soil and water resources

“IF YOU HAVE GOALS FOR ONE YEAR, PLANT RICE

IF YOU HAVE GOALS FOR 10 YEARS, PLANT A TREE

IF YOU HAVE GOALS FOR 100 YEARS, THEN EDUCATE A CHILD

IF YOU HAVE GOALS FOR 1000 YEARS, THEN PRESERVE THE ENVIRONMENT.”

CONFÚCIO



Thank you!

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