

Badiru, Ajibola Isau; de Pires, Maria Aparecida Faustino

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## Ecological framing of the urban and rural water basins for Environmental Planning - Case of Registro-SP, Brazil

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# **ECOLOGICAL FRAMING OF THE URBAN AND RURAL WATER BASINS FOR ENVIRONMENTAL PLANNING: CASE OF REGISTRO-SP, BRAZIL.**

**45<sup>th</sup> Congress of the European Regional Science Association "Land Use and Water Management in a Sustainable Network Society"** Vrije Universiteit Amsterdam 23-27 August 2005

Ajibola Isau Badiru  
Maria Aparecida Faustino de Pires

Instituto de Pesquisas Energéticas e Nucleares - IPEN  
Centro de Química e Meio Ambiente – CQMA – CEP 05508-080 – São Paulo - SP, Brasil.  
aibadiru@ipen.br; mapires@ipen.br

## **Abstract**

This research aims at reframing sub-regional water basins for adequate system planning. It takes into consideration the physiographic characteristics of a municipal area situated in the coastal Brazilian Atlantic region. Our research observes the landscape elements, investigates land and water lines with their respective zones, as they are conceived and integrated with the urban areas and the rural zone that is associated to the flood plain and the high lands. Four parts of sub-regional water basins were identified and studied for community water basin management. However, urban equipments associated with the natural and human systems were translated into maps and evaluated together with Satellite imagery (Landsat-7UTM RGB-453) in order to reframe the municipal area into micro *water units* for strategic planning. Symbolic elements were considered as *prime vectors*, distinguished to illustrate different environmental patterns involved in the determination of micro water units. This technique has correlated maps for integrated analyses, by drawing attention to the city image associated to environmental resources in the regional and local territories. Such understanding has clearly revealed special patterns that hold the urban pressures and shows how the vectors of expansion forces are connected to the internal and external forms, the types of natural and artificial sub-systems and the bio-physiographic conditions. Our analysis has evaluated the local water structural zones for its use in the actual decision making process (DMP), utilizing Urban Focus Chat (UFC), to slot the spatial and systemic approach of the general framework of *water units* into other environmental values relating to sub-systems. Adequate references and ecologic values are vital in planning and in system management required for the development of strategic action.

**Key-words:** strategic planning; urban elements; hydrographical basin; natural resources and regional planning.

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## **Introduction**

In Brazil, since 31<sup>st</sup> of august 1981, the federal law (Lei n° 6.938: Act.9, § II) has consolidated the creation of effective environmental instrument on the national and regional realms. On the other hand, the actual process of decision making on public policies needs technical information for strategic actions relating to environmental planning, especially, on the environmental zones of land and water resources (CETEC, 2001), which are interrelated in occupational use and in strategic planning.

Despite that environmental zoning is one of the key issues relating to the preservation of natural resources, with Direct Plan and Development Code, on the same subject, as the instrument towards normal and adequate measures with legal arrangements, lots of efforts have failed to comply with such instrument in favor of local (municipal) areas where sub regional assessments are required in adequate systemic approach to protect forest and water reservation areas against continuous urban expansion and pressure. The metropolitan area in Sao Paulo State is facing serious environmental problem (Victorino, 2001; CETESB, 1999; 2000; SÃO PAULO, 2000), nevertheless, it is connecting the hydrographical region where Registro-SP urban area is located, interlinked to other cities that are surrounded by several areas of legal environmental protection.

However, our research has focused on the classification and on the zoning of micro water basins of Registro-SP, aiming at contributing with an instrument, that may support the formulation of the municipal Direct Plan and Development Code for the territorial layout and contribute towards the adequate use in consonance with intrinsic values and legal considerations specified by CONAMA 020/86 and other Acts and recommended by CETESB in 1989.

In this case, physiographic information of several maps has synthesized the natural and social equipments of landscape analyses (McHarg, 1972; Badiru, 1999). Our approach has complied with social dimension through the evaluation of the structural pattern of urban equipments, in relation to urban image (Badiru *et al.*, 2004; Healey, 2002). Ecologic framing sought for homogeneity of natural and social pattern of each sub-system, considering sufficient physical space for the maintenance and protection of fauna diversity and river fonts, the avoidance of geological risk as well as the maintenance of natural drainage system.

Our results have revealed 17 specific water units from spatial parts of sub-regional water basin of the main hydrograph. Making an integrated analysis of the urban and natural subsystems

with thematic maps, it was observed that defined water units suggest strategic development for a probable approval of urban population (density) in such location.

The framing of water units has followed three steps by overlaying the thematic maps to combine various aspects of the investigation and schemes. In the first step, *prime vectors* were utilized to perceive the “city image as collective resources”. The features of built urban were evaluated in the municipal scale and integrated in the hydrographical regional. The second analysis utilized four patterns determined by physiographic features to identify micro homogenous environment of the natural landscape process pursuing same values. The last step have integrated the results of the first two steps by using a UFC (Urban Forest Chat) in order to organize, explore and integrate the spatial information.

### **The built environment perceived in the local and regional hydrographs by ecologic vectors.**

In two different analyses, according to the ecologic urban investigations, structural analyses of four *prime vectors* (*waterlines*, *landlines*, *firelines* and *airlines*) have aided to understand the physical transformation relating to the net urban centers: in the regional hydrograph considering 23 urban cites interconnected in the hydrographical region, and the other in the local, with regards to the municipal territory of Registro-SP and adjacent areas.

The spatial compositions of the four prime vectors are sequentially observed in ecological analysis. Their integrated pattern *enfolds* the net urban structures, which were found to be interconnected by three different clusters. The logic behind such rational and symbolic framing (Badiru, *et al.*, 2004), is based on ecologic understanding of the “complementary” resources owing to the combination of the natural and cultural elements that have provided the physical transformation to the physical urban image (Figures: I;II;III e IV).

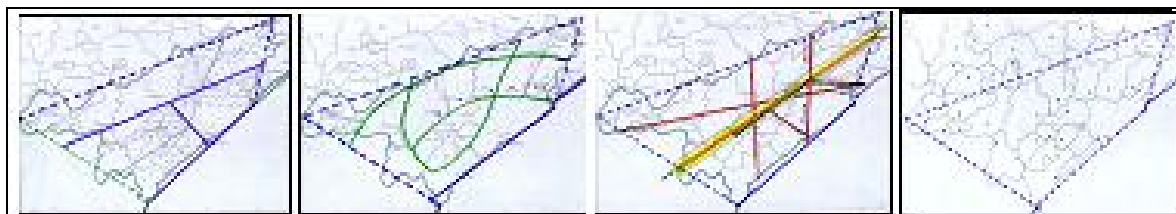


Fig. I -Water lines      Fig. II - Land lines      Fig. III - Fire lines      Fig. IV - Air lines

The structural synthesis of the same four prime vectors has revealed the connectivity of cities, involving the spatial pattern and determined by environmental forces. The internal urban

pressure depends on the city connecting the *prime vectors* with external areas, especially, those already transformed, interrelated in the clusters, within the core of the hydrograph where Registro-SP is located (Figure V).

However, the driving forces relating to human settlement is also from the external, through the Brazilian-Road (BR-116), and from the expansion already raised by the proximity of the Metropolitan area of São Paulo-SP and Santos-SP toward the Beach areas. The most crucial equipments that is responsible for the human accessibility and consequently physical transformation is the connection of Sao Paulo and Curitiba, capital of Parana State in the southern part, also along the Brazilian Road (Br-116). Other social and geopolitical factors are specific in each of the urban cities. Although, the water quality of most of Vale do Ribeiro de Iguape is considered to be of good standard, the agricultural and urban influence are intensive, especially in the district and localities associated to flood plain and wet lands.

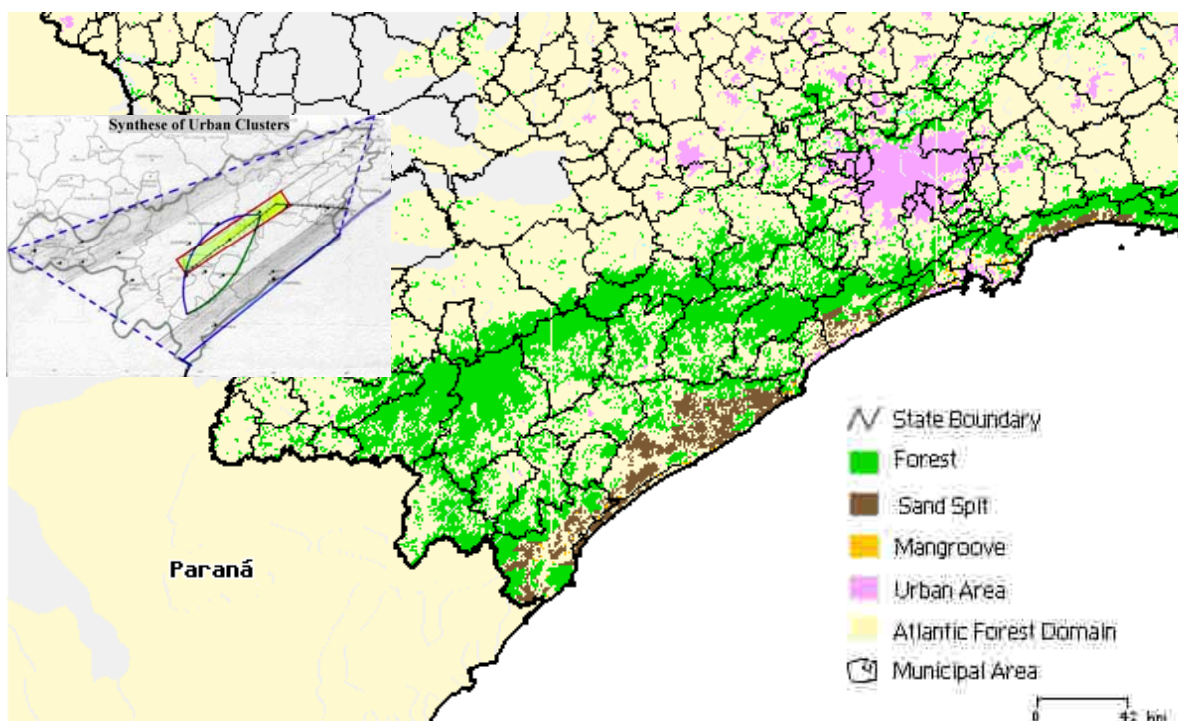


Fig.V- Map - Atlantic domain (Fund. SOS Mata Atlantica); Synthesis of the four prime vectors integrated

The Registro-SP municipal area now has the highest urban population of about 55,000 (fifty five thousand) inhabitants. It is the capital of the hydrographical region called *Vale do Ribeira de Iguape-SP* (23° 45'S / 46° 45'W e 25° 30'S / 50° W). The Registro is right in the

centre, controlling the other municipal areas consolidated in satellite images: Landsat-7UTM RGB-453 (Figure V). various factors relating to the natural urban landscape formation are associated to the cluster of cities (Badiru *et al.*, 2004). Some have justified the reason for its internal economic and social activities to elucidate why Registro-SP has a greater participation in the internal process of net urban dynamics and expansion. In opposition, the fertile valley area is associated to some of these municipal areas characterized by flood plains, where flood disasters are frequently recorded.

In the local examination, the municipal area of Registro-SP consists of 4 parts of sub-regional water basins, which were taken as principal “*water zones*” while “*land zones*” separate flood areas in the municipal areas. Representing different areas of human access, “*Fire zones*” are found by observing pattern and continuity of roads and the main river. Finally, the “*air zones*” were derived from the Urban Perimeter prescribed for the Urban Zone (Figure VI; VII; VIII and IX).

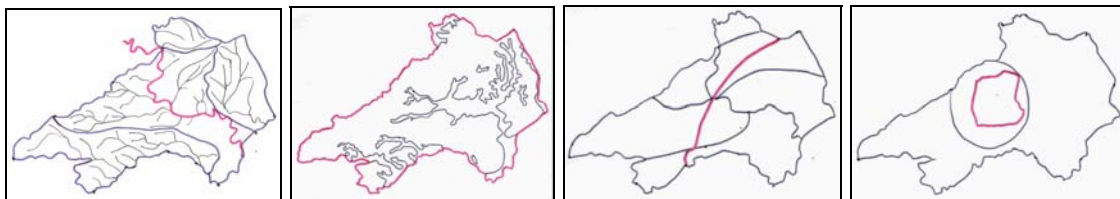


Fig. VI -Water zones

Fig. VII - Land zone s

Fig. VIII - Fire zones

Fig. IX - Air zones

Environmental pattern on each of the *ecologic* zones was aided by the introduction of specific structural lines and areas based on the local river structure, the green and urban spaces, the road structure and on the urban areas, respectively. Though the integration of different zones by maps is a very complex information, the basic objective is the general view of water features relating to the land, urban expansion and level of human access that strongly mobilizes others in the physical transformation process.

### **The physiographic and social values determined by natural and artificial patterns.**

In this analysis, the spatial pattern of three maps was rationalized to understand the land water and human attributes. Bio-physiographic understanding of the natural environment has

been synthesized by geomorphology and hydrology maps overlaid on the resulting of principal vectors derived from the first analysis in the local scale.

We have found a strong correlation between the natural areas pertaining to the three maps (soil, the geologic maps and the geomorphologic pattern) consisting of three major areas associated with the Bar of Juquia River, the crucial point of two main lines: 1) one down to the east and another down from the same bar down to the west. The middle area where the city is centered is exactly in the areas governed by the main river Ribeiro de Iguape.

The low level of human access is associated on the eastern part to the distance from the urban centre and the flood plain along the main river not along the river sides. Lines of geomorphologic and hydrologic pattern are brought together resulting in one of the four principal vectors in the general map.

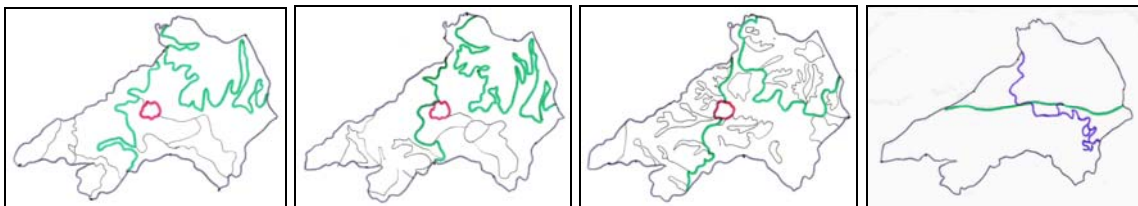


Fig. X – Geomor. Pattern

Fig. XI- Geologic Pattern

Fig. XII - Soil Pattern

Fig. XIII - Water Segment

Ecologic framing at this stage has recognized a new subdivision of the 4 *water zones* in the 17 different *water units*. While the first water zone in the north remained unchanged, the other remaining parts were subdivided. The central and the southern shared the most significant sub divisions.

Details of the ecological urban image have contributed to the ground focus of sub basin and also to the spatial definition with lines, for differentiating urban areas and future tendencies observed relating to the general patterns. The perception of *lines*, *zones* and nature have guided the entire subdivision of the 4 sub-regional basins in the 17 *water units* (Figure: VI). The spatial and ecologic *references are* related to the municipality with the region structures and with *prime* sub system.



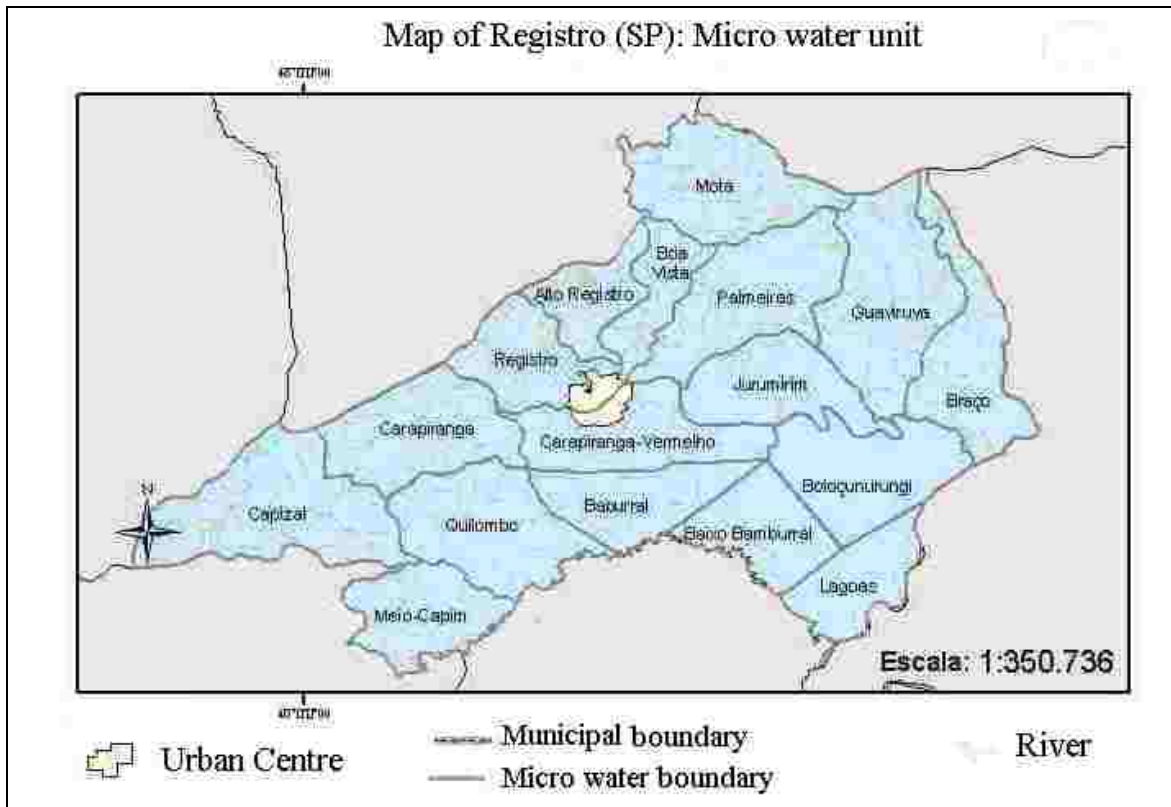


Fig. XV- Registro (SP): Environment water Unit for Strategic Plan (Source: CQMA/IPEN; Base: IF. 1979).

### Sub-water basin environmental classification by utilizing Urban Focus Chat

We have also identified the general patterns and environmental values in the first two steps that are now added to the third step for a clearly systemic and technical applicability, considering each classified water unit as environmental and geographic reference. Such factors can then be, specifically, catalogued for ecologic records by incorporating the use of the UFC positioned in the geographic centre to explore and integrate each unit in environmental analysis, management or planning (Badiru *et al.*, 2005).

In this case the UFC is positioned in the geographic centre, various units identified can be undertaken and treated in systemic management based on the concept of *information plan* as in the ROI (Region Of Interest) spatially aided with GIS (Geographic Information System). A hierarchical urban morphology of the UFC was applied for spatial value to be integrated and indexed for each water units.

With this chat overlaid our research has accomplished its main objective, which is to find systemic basis for local water hydrographical units to be managed together with the sub-system



under environmental planning. This method can also be applied specifically, to increment any urban facilities or equipment for spatial environmental resources.

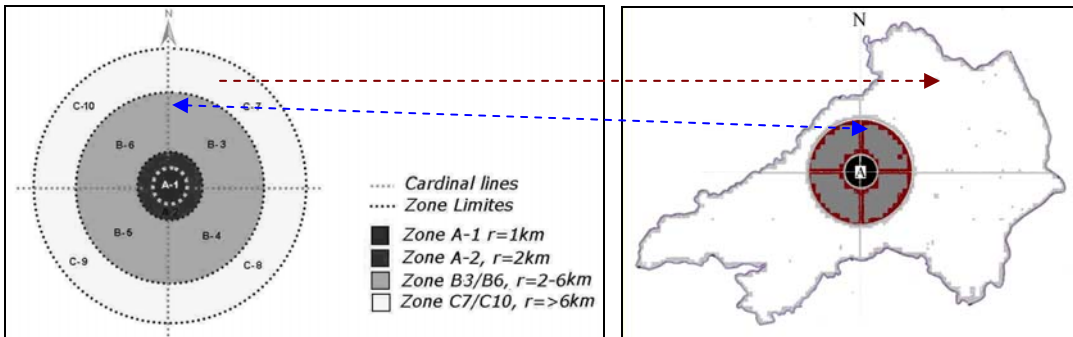


Fig. XV UFC-Urban Focus Chat (Badiru, et al 2005), in Registro-SP: Internal and External environment

Though all steps and methods have focused on the Municipal area, in the territorial effects of interrelating urban clusters, the issue seems to be far beyond its political boundaries, with pressure extending to neighboring urban setting.

## Comments

The devastation of the native Atlantic forest means that there is need adequate planning of the concept of urban forest as *built environment* and its future prospects to become a sustainable arena for human habitat (Brasil, 2000). Land, water, and social values are directly involved and associated to equipments and occupational utilities.

The basic focus then may be on the environmental hazard, because there are areas that are not supposed to have been urbanized. Many of such land occupation imply the reduction of water area. The strategic question is to decide which areas are supposed to be urbanized or used adequately.

Even though preserved area may look cheaper than others, initially maintained natural qualities make land much valuable, but care must be taken when restrictions are imposed on land or watersheds. Such engineering also means restructuring the administrative system (Healey, 2002), in order to let the people indicate what they prefer or desire so that action is provided based on their desire.

An ecological unit is subject to environmental classification accounting for the inter-relations between the *biotic* and *abiotic* components. Consequently, for effective urban planning,

it is necessary to organize the types of vegetation in order to establish adequate management criteria and monitoring programs for strategic development.

With a simple comprehension of nature and the associated links between space and time, for this type of study, there may be need for computer based model to aid territorial management and control. Pattern and process of environmental structure and models may explore such information for further development of spatial knowledge.

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