SUSTAINABLE WATERSHED MANAGEMENT PROGRAM FOR THE RIO GRANDE IN UBATUBA: A SEARCH FOR SOLUTIONS FOR THE MAINTENANCE OF WATER YIELD AND WATER QUALITY

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ABSTRACT.

The actions referred to in the Sustainable Watershed Management Plan for the Rio Grande in Ubatuba are as follows: The survey of the hydrological potential of the most important water supply watershe; the identification of the main problems affecting the water yield and water quality;and the definition, in association with the local community and several governmental entities, of the strategies for the preservation of the watershed.

To preserve this important watershed, which has its headwaters located in the coastal hills of Serra do Mar, draining to an area almost completely covered by native Atlantic Forest vegetation, and declared by UNESCO as a patrimony of humanity, is the challenge shared by the technicians and the community representatives in order to guarantee water yield and water quality for present and future generations. The present project intends to present the participative process in the elaboration of the Sustainable Watershed Management Plan for the Rio Grande in Ubatuba and the main results obtained during the two years of implementation.

***Key-words**: water resources, water supply catchments and participative planning.*

1 INTRODUCTION

The Rio Grande in Ubatuba is a strategic watershed for the city of Ubatuba and it is responsible for the water supply of 88% of the population, which receives treated water from a public service concessionaire. Most of the watershed area is covered by native Atlantic Florest vegetation. The area under study was declared by UNESCO as a Biosphere Reserve in the Man and Biosphere Program (MAB), establishing it as patrimony of humanity of international importance.

The headwaters and the streams forming the Rio Grande watershed are located in the coastal hills of the São Paulo State Park of Serra do Mar (PESM), an area of great contribution to the

hydrological production in the watershed. This Park was created by State Decree No. 10,251/77, (SÃO PAULO, 1977) and it is also considered by the National System of Conservation Units (SNUC), under Federal Law 9,985/02 (BRAZIL, 2002) as a conservation unit, whose main objective is to keep the ecosystem free from alterations caused by human interference, allowing only the indirect use of the natural resources.

Although the watershed is almost completely covered by forest, which provides high quality water and with enough availability to meet the current needs of the population, the risk of watershed degradation is eminent, due to population increase, and the lack of consistent urban development planning, especially regarding the area located above the water intake area.

The elaboration of integrated planning for the watershed, involving several social sectors, has the objective of identifying the main problems affecting water yield and water quality, and the definition, in association with the local community, of the actions for the preservation of this important natural resource.

2 THE IMPORTANCE OF THE FOREST IN THE WATER PRODUCTION

The modifications in the natural environment, the transformation of forests in cities or agriculture and pasture fields, contribute to the alteration of the watershed hydrological cycle (ARCOVA et al.,1998). The forests current situation in the State of São Paulo is not convenient for the maintenance of the soil, water yield and water quality, and a great effort shall be necessary in order to promote the recovery of the areas. (CICCO & ARCOVA, 1999).

The forest cover plays a major effect in the terrestrial portion of the hydrological cycle, with direct influence in the main components related to rainfall interception, infiltration and regularization of streamflow regime.

Besides that, riparian vegetation contributes to the protection of the riparian areas, filtering sediments and nutrients, the control of erosion in channel banks, the control of the temperature alteration in the aquatic ecosystem and water pollution (LIMA, 1996).

It has been especulated that the recovery of riparian vegetation contributes to the increase of the water storage capacity of the catchment, which contributes to the increase of the discharge during the dry season (ELMORE & BESCHTA, 1987) apud (LIMA & ZAKIA, 2000).

According to LIMA & ZAKIA (2000), the direct effect of the riparian vegetation in the maintenance of the catchment water quality has been demonstrated in several experiments. The function of the riparian areas has, with no doubt, immediate practical application for catchment management (KUNKLE, 1974). The riparian areas, that strategically isolate the streams from the higher terrains, have an efficient action of filtering of the surface sediments (AUBERTIN & PATRIC, 1974), (KARR & SCHLOSSER, 1978), (SCHLOSSER & KARR, 1981), (BAKER, 1984), (MORING et al., 1985), (BORG et al., 1988), (ADAMS et al., 1988), (ICE et al., 1989), (MAGETTE et al., 1989). Most of the nutrients released on the terrestrial ecosystems reaches the stream water through solution transportation in the sub-surface drainage. Such nutrients, when crossing the riparian areas, may be efficiently retained by means of its absorption by the root system of the riparian vegetation, as observed in several works (AUBERTIN & PATRIC, 1974), (PETERJOHN & CORREL, 1984), (FAIL et al., 1987), (DILLAHA et al., 1989), (MAGETTE et al., 1989), (MUSCUTT et al., 1993).

3. THE FORUM OF DISCUSSION

According to TUCCI, (2000) "the impacts produced by urban development occur, among other factors, because the municipalities do not have the institutional and economic capacity to administrate the problem, while the states and the Federal Government are too distant to look for a suitable management solution. Each of the problems is treated in an isolated way, without preventive or recovery planning. As a consequence, we can observe economic damage, a marked degradation in the quality of life, the return of diseases of hydrological propagation, deaths, asset and residence loss, interruption of commercial and industrial activities, among others. The cost of prevention in the planning phase is much lower than the cost of recovery action."

The discussions regarding watershed environment impact and the necessity of the implementation of efficient environment control measures occur within the context of the Northern Coast River Basin Committee (CBH-LN). A working group was established in July 2000 (Rio Grande Working Group), initially composed of members of the CBH-LN and later including representatives of the legislative and judiciary bodies and community organizations, such as the association of watershed residents. Presently, the group also includes members of the following government institutions: the Forestry Institute, the State Sanitation Company, the State Board of the Water Supply Company, the Environmental Police, the State Department of Water and Electricity, the State Department of Health, the State Institute of Lands, the State Department of Natural Resources Protection, the State Department of Agriculture, the State Department of Architecture, Urban and Sanitation Vigilance, the Municipal Secretary of Agriculture and Fishing, the Justice Department, the City Council, the Local Newspaper and the University of São Paulo.

4. AL BACKGROUND

The water and forests integrated conservation policy is supported by the Brazilian Environmental Policy (Federal Law No. 6,938/81), the Brazilian Water Resources Policy (Federal Law No. 9,433/93), the São Paulo State Law 7,663/91, the Brazilian Forest Code (Federal Law No. 4771/65), Federal Decree 750/93, as well as related Federal legislation.

5. OBJECTIVES

The project has as its objectives, the survey of the watershed hydrological potential as a water supply area for the town of Ubatuba; the identification of the main problems affecting water yield and water quality; the establishment of strategies and watershed management practices that are recognized as sustainable, in association with the local community and several governmental entities.

6. MATERIAL AND METHODOLOGY

6.1. Basin Morphology

The Rio Grande watershed is responsible for the water supply of 88% of the population, which receives treated water from a public service concessionaire. This watershed has its headwaters located in the coastal hills of Serra do Mar, and is covered by native vegetation, denominated Dense Tropical Rain Forest, within the Atlantic Rain Forest domain.

The area under study is located between these geographic coordinates: 23°22' to 23°25' South and 45°04' to 45°10' West. The area is known as "*Pé da Serra*" and includes the areas located

along the Oswaldo Cruz Highway, Floresta Street , Mirante Street , Ponto Final Street, Colônia de Férias Street, Sitieto, Jipão Street and Trails , with area of approximately 30 Km^2.

The area has a Wet Tropical Climate (Af) with a transition into Cfa, with a strong oceanic influence. The average annual temperature in the region is 21.2º C, ranging from 17.0º to 26.8º C, having an average rainfall of 2,624.0 mm.

The region belongs to a geographic unit named "*Serraria Costeira"*, with altitudes ranging from 15 to 1042 msnm. The hillsides are steep, with slopes ranging from 25 to 45º, and some sloping more than 45º in the upper zones of the mountain range, especially at the basin's end. In the middle section of the mountain range, slopes vary from 12 to 25º. At the back of the valley slopes are around 6 to 12º and these zones circle the park. In figure 01 we present the classes of altitudes, the borderlines for the water basin and water resource study area.

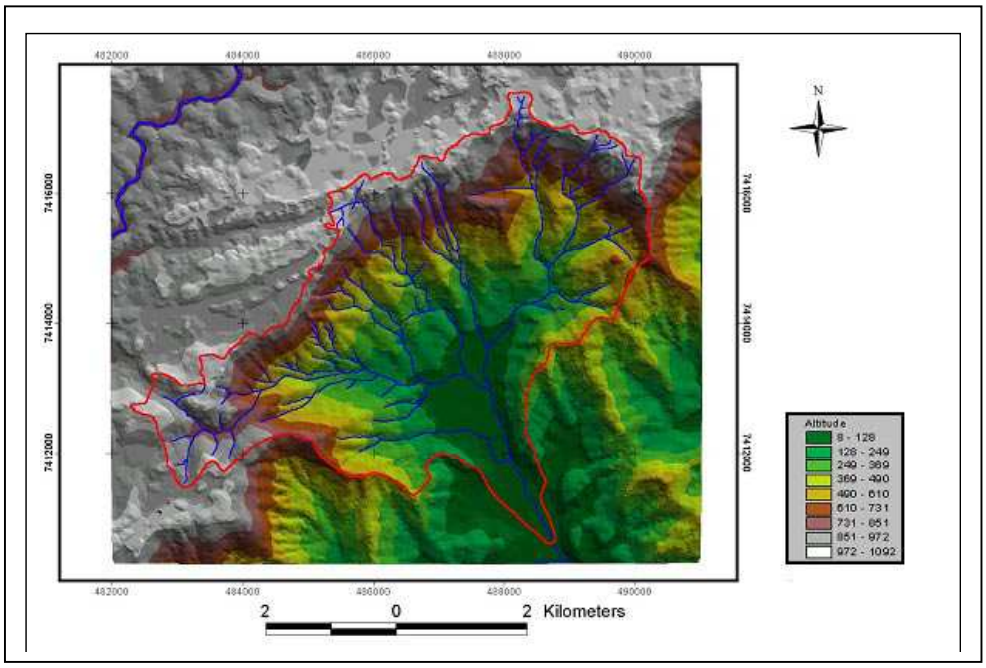

Figure 01: physical delimitation of the basin and classes of altitude

6.2. Planning Methodology

In analyzing the demands of this watershed, based on water quantity and quality, a potential conflict was observed. The visualization method was used to facilitate the identification of the problems. A panel indicated each identified problem, and the participants were able to identify the reasons for the environmental degradation and the consequent risk of contamination and decrease in the water yield as a consequence of unplanned urban development, which provokes the discharge of untreated wastewater into the waterways, illegal diversions of water, and forest devastation.

A debate on the questions related to the problem occurs twice a month, with the schedule of proposed activities, in order to articulate the participation of the consenting entities.

A data base containing the information obtained in the meetings, the research *in loco*, and the cartographic surveys has been implemented in order to determine actions for the sustainable management of natural resources, ratifying the areas in which the restriction aims are required to the watershed protection.

Management Planning has been gradually implemented. Four thematic sub-groups were created: (i) Protection, Conservation and Recuperation of the degraded areas; (ii) Management; (iii) Water yield and water quality and (iv) Divulging, training and environmental education.

For each of these themes, a planning matrix was established, containing the following entries: fundamentals, actions, goals, timing, direct stakeholders, partners, financial sources, and environmental indicators. After a thorough discussion within each group, the results were opened to a general, deliberative conference, with the participation of all members of the working group. The analysis of the final results will be presented in an open public hearing. Many short and long term actions have already been executed, since the creation of the work groups.

7. RESULTS AND DISCUSSIONS

We present below the main activities implemented for a period of two-year execution, according the planning matrixes in accordance to table 01 to 04.

Table 01: Activities of Participative Management Planning, developed during a two-year period for the planning matrix: protection, conservation and recuperation of the degraded areas.

1.1.Elaboration of a report by the GT - Rio Grande on the risks to public health caused by human occupation.
1.2. Identification of the occupied areas inside the Park, survey of environmental degradation, the relevant legal instruments and basic mapping. The results of this work were submitted to the São Paulo Justice Department for the interposition of a public civil action for environmental damages. 79 illegal occupations were identified, used for leisure, summer resorts, subsistence agriculture, habitation, among others.
1.3. Out of the seventy areas identified in the survey, forty legal actions were filed by the São Paulo State Ministry of Public Prosecution.
1.4. Implementation of a monitoring and inspection plan with weekly inspections by the Environmental Police and the Forestry Institute inside the PESM. Out of the seventy areas identified in the survey over two years, twenty two were evacuated.
1.5. Implementation of a plant nursery in association with the “Agronomic Institute of Campinas” (IAC), the University of Taubaté (UNITAU), the Forestry Institute, the Forest Foundation, Votorantim Paper Company (VCP) and the Municipal Government. VCP has donated 20.000 native plants.
1.6. Implementation of a plant nursery in association with the “Agronomic Institute of Campinas” (IAC), the University of Taubaté (UNITAU), the Forestry Institute, the Forest Foundation, Votorantim Paper Company (VCP) and the Municipal Government. VCP has donated 20.000 native plants.
1.7. Reforestation of native vegetation on fifteen properties. The reforestation project includes the selection and registration of the areas, the selection of plants, input material, digging and planting, carried out in association with the Municipal Government, UNITAU, IAC, Forest Foundation and Forestry Institute.

Table 2: Activities of Participative Management Planning, developed during a two-year period for the planning matrix: Management.

2.1. Social and Economic Survey: interviews with residents, domestics and illegal occupants over 90 areas inside the Park. The survey enabled the establishment of a profile of the hydrological production area occupants. One of the objectives of the survey is the identification of the poor families for their posterior removal to appropriate areas. The survey has been carried out in association with the Rural Workers Union, the "Amigos do Pé da Serra", the Forestry Institute and ESALQ/IPEF. Elaboration of a report by the GT - Rio Grande on the risks to public health caused by human occupation.
2.2. Translocation of poor inhabitants from the Park area: search for financial resources, technical inspections for the identification of adequate areas for replacement, elaboration of a plotting project. Such activities have been accomplished by the 'Sociedade Amigos da Praia das Toninhas', the Environmental Police, the DEPRN, the Municipal Government and the Forestry Institute.
2.3. Plotting project for the replacement: The project, elaborated by the Municipal Government, was submitted to the "Friends of Toninhas Beach Society", the Justice Department, the DEPRN and the Forestry Institute. After the participants agreement on the area to be chosen, the next phase of the project will be the Environmental Permit. Out of the seventy areas identified in the survey, forty legal actions were filed by the São Paulo State Ministry of Public Prosecution.
2.4. Physical delimitation of the park and land property regularization: Efforts have been made by the Environmental Secretariat and the State General Attorney, in association with the State Institute of Lands, the Forestry Institute and the Municipal City Council, in order to realize the delimitation of the park to avoid further degradation. A monitoring and inspection plan has been implemented with weekly inspection operations by the Environmental Police and the Forestry Institute inside the PESM. Out of the seventy areas identified in the survey over two years, twenty two have been evacuated.
2.5. Submission of the proposal for the implementation of the "Mananciais Protection Zone" in the area of the Rio Grande watershed, i.e., the area located above the Municipality water catchments area. The proposal has been submitted by GT Rio Grande to the group responsible for the elaboration of the Municipal Directive Plan.

Table 3: Activities of Participative Management Planning, developed during a two-year period for the planning matrix: water yield and water quality.

3.1. The quality of the water located above the point where the water is collected to public distribution are from now monitored by CETESB quarterly. The monitoring program includes physical, chemical and bacteriological analysis. Contacts with UNICAMP have been made regarding the installation of daily water measurers for the analysis of the water's physical and chemical conditions. Elaboration of a report by the GT – Rio Grande on the risks to public health caused by human occupation.
3.2. Monitoring of the water distribution system by the State Department of Health and Sanitation Vigilance. The six-monthlyl reports are divulged during the GT –Rio Grande meetings.
3.3. Hydrological studies for the identification of the watershed, installation of limnigraphs for the daily measure of the water yield implemented by the Forestry Institute and the ESALQ.

Table 4: Activities of Participative Management Planning, developed during a two-year period for the planning matrix: divulging, training and environmental education.

4.1. Execution of an agreement with the local media for the publication of the activities developed by Rio Grande. The activities have been published by Globo Network, Bandeirantes Network and independent productions. Articles have been published weekly by "A Semana de Ubatuba" newspaper.
4.2. Cleaning movement in the Rio Grande, organized by the "Friends of Pé da Serra" in association with the working group.
4.3. Conferences in schools organized by the "Residents' Association of Pé da Serra", Forestry Institute and ESALQ-USP.

The major challenge faced during the first phase of Participative Planning for the elaboration of the Sustainable Watershed Management Program was the articulation of pre-existing entities, which had accumulated the executive functions with great expertise in water resources and a great affinity with the basin inhabitants representatives. This challenge has been overcome due to the existence of the Northern Coast River Basin Committee, which has an important role in the compatibility of the different regional interests.

In only two years of project development, many activities were implemented. It is possible to emphasize as relevant activities in the process (i) the participative view in the processes for the elaboration of the sustainable watershed management program (ii) the multi-focal work with the participation of several organs (iii) the diversity of the activities in several fields (public health, disorganized occupation, environmental education) (iv) the direct and open contact with the local community for the discussion of subjects such as the illegal possession of areas, the necessity of translocation of the poor families, and the necessity of legal actions requesting demolition orders.

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