# Avaliation of Turbidity Rate, Land Use, Surrounding Forest and Landscape Format  in the Pato Branco River

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**Abstract**: The Pato Branco River is the responsible by the supply of potable water to Pato Branco City. This project executed during 1998, 1999 e 2000 was born from the necessity of increasing the water quality of Pato Branco River. It was conduced by the CEFET-PR and the Mariópolis City Hall.  The methodology adopted was the environmental diagnostic. It was realized the collect and analysis of water samples in the rivers of the manancial. The environmental diagnostic compiled information about de landscape format (concave or convex), system of soil use (especially the kind of till) and the situation of surrounding forest (present or absent, altered or not) also was investigated the  area of de farms in the border of the rivers. After was realized  correlation analysis between the results of the environmental diagnostic and the results of analysis of water samples.  The result shows that 60% of the points evaluated had problems whit surrounding forest. There is also a correlation between the landscape format and the turbidity of water,  pH of the rivers, the kind of soil use. The presence or absence of surrounding forest had the highest correlation whit the pH of the rivers.

**Keywords**: Landscape format, water quality, environmental diagnostic, surrounding forest

## 1   Introduction

The economic aspects had the highest value in the development of the agriculture in the Parana State in Brazil. This fact was characterized by the large adoption of  machines and industrialized insumes, taking to two results: the removal of the man of the field   and the degradation of the natural resource.

The Pato Branco river, located in Mariópolis, Parana South of Brazil is an example of area in continuos process of degradation. This manancial are composed by the Pato Branco river and five important affluents (the rivers Panela, Conrado, Manguerinha, Lambedor and Pinheiro)  and for a lot of small tributary. The expression manancial was adopted because only the area above the point of caption of water for the treatment was evaluated.

The Pato Branco river  is responsible by the supply of potable water to Pato Branco City. It is considered of public interest for this, according with the State Law 59/91. This law determines that 5% of the global value of the ICMS (Merchandises Circulating Tax) came back to the cities that had Conservation Unities or Manancial areas (PARANA, 1996).

The objective  of this project was to do the recuperation and protection of the manancial area of the Pato Branco river using as indicator of the quality of environmental  the quality of the water.

## 2   Methodology

The methodology adopted was the environmental diagnostic. It was realized the collect and analysis of water samples in the rivers of the manancial. The environmental diagnostic compiled information about de landscape format (concave or convex), system of soil use (especially the kind of till) and the

situation of surrounding forest (present or absent, altered or not) also was investigated the area of de farms in the border of the rivers.

The diagnostic was realized using technical of landscape reading, interview whit the farmers and answered some systematic questions. The landscape reading means to watch aspects of the landscape as kind of relief, landscape length and format (shape), slope and to cross this information whit others like the system of soil use, kind of vegetation present in the area and others. This evaluation was done in each 500m, or in each propriety (farm). All the farms of the manancial was visited and evaluated.

Information about the kind of use of soil, presence of erosion, presence or absence of surrounding forest, protection fence, presence any kind of trash was anted and availed. The presence of surrounding forest was classified as altered or not altered.

It was realized the collect and analysis of water samples in the rivers of the manancial. The collect was done each fifteen days and was analyzed the pH, color, turbidity, iron, oxygen, DBO (biochemical demand of oxygen) and DQO (chemical demand of oxygen), according VON SPERLIG, 1996.

After was realized correlation analysis between the results of the environmental diagnostic and the results of analysis of water samples.

## 3 Results

The area of Pato Branco River manancial of was divided in five Planning Unities. Each Unity was correlated with a river affluent of the manancial. They are Lambedor river, Conrado river, Panela river, Mangueirinha river and Pinheiro river.

There are about 70% of familiar farms with less than 120 acres and only 0.9% with area bigger than 1,370 acres in the manancial. 20% of this farms had a low technological level, whiteout adoption of insumes, 30% whit a middle level and 50% with a high level, (adoption of machinery, fertilizers and treated seeds) (MELLO *et al*., 1999).

In Brazil the federal legislation defines that a border of 30m around the river smaller than 6m of large should be conserved with the surrounding forest (PARANÁ. 1997). In the little farms (area smaller than 120 acres) is usual the use of this areas for annual tillage or pastures because normally it are the only area in the property that had deep soils, plane relief and potential to mechanization . The diagnostic shows that 60% of points evaluated had problems with de surrounding forest. These problems was the absence of protection fence, forest very alterated, size under the recommended by legislation etc. In this article was considered only presence or absent of the surrounding forest. This forest is very important in the environmental context because the balance of the ecosystem depends of it development (BET, 1969). It is a kind of refuge to animal species, a filter to the water proceeding of the agricultural areas and a carbon fixer.

The problems with the surrounding forest not is a isolated problem, but a consequence and a reflex of other technical problems as the absence of protection fence, absence of research to find forms to use the areas with high slope and social problems as the reduced size of the familiar farms, that conduced to increase the pressure of use over all the soils of the propriety.

The percentage of surrounding forest altered and absence of protection fence was the same. This indicates that is thin relation boot factors. The absence of physical limit (fences) permit the agricultural activities attacks gradually the area of surrounding forest, and permits the animal (especially the cows) had a direct access to the river, causing erosion in the borders of the rivers.

However the surrounding forest had an important contribution to the quality of water, it not is the principal aspect relationed with the contamination of manancial. The landscape format (concave or convex can accelerate or reduce the intensity of the process. The distribution of landscape format in the manancial area is in the Table 1.

**Table 1    Percentage  of  predominance of  landscape format in the
Unities of Planning of  manancial area**

| Unity | Concave | Convex |
|-------|---------|--------|
|  | % |  |
| Panela | 41,38 | 27,59 |
| Mangueirinha | 36,36 | 38,18 |
| Lambedor | 45,45 | 18,18 |
| Pinheiro | 44,90 | 34,69 |
| Conrado | 46,70 | 33,20 |

The percentage do not closed in 100% because are the straight format to. The information shows that are a predominance of concave landscape in the Unities Conrado, Lambedor and Pinheiro. Consequently, in this Unities are landscapes that collect water. According CRISTOFOLETTI, 1980, in this kind of landscape prevail severe process of erosion. The Manguerinha Unity is the only one that has prevailed of convex landscape (distributer of water).

**Table 2   Percentage of presence and absence of surrounding forest in the
Unities of Planning of manancial area**

| Unity | Absence | Presence |
|-------|---------|----------|
|  | % |  |
| Panela | 14,55 | 69,09 |
| Mangueirinha | 44,88 | 37,93 |
| Lambedor | 29,55 | 70,45 |
| Pinheiro | 28,57 | 69,39 |
| Conrado | 20,30 | 67,70 |

As presence of surrounding forest was considered all kind of forest, and in this paper the condition altered or unaltered and the extension is not considered.

Table 3 shows the soil use, was considered areas with pastures (yearly or continual), annual tillage and others (in this category are specially reforestation and uncultivated areas)

**Table 3   Percentage of kind of soil use in the Unities of Planning of manancial area**

| Unity | Crops | Pasture(%) | Others |
|-------|-------|------------|--------|
| Panela | 52,30 | 27,00 | 14,00 |
| Mangueirinha | 40,00 | 46,00 | 20,70 |
| Lambedor | 61,01 | 20,12 | 18,87 |
| Pinheiro | 80,00 | 10,09 | 9,91 |
| Conrado | 63,15 | 30,50 | 6,35 |

The pH and the turbidity rate were correlated whit format (shape) of landscape and type of soil use. In the Unities Conrado, Lambedor, Panela and Pinheiro there is predominance of concave landscape and in the Mangueirinha Unity predominance convex landscape format. In the concave landscape are common erosion processes most intense. The results for pH shows that exists a process of contamination of the river with lime that are increasing the value of pH, normally about 6 to 6,5. All the Unities presented values over this one (Table 4).

**Table 4    pH grouped in half yearly means\* for the Unities of Planning of manancial area**

| Half yearly | Panela | Mangueirinha | Lambedor | Pinheiro | Conrado |
|---|---|---|---|---|---|
| 1° | 6,6 | 6,8 | 7,0 | 7,0 | 6,9 |
| 2° | 6,8 | 6,8 | 7,0 | 7,0 | 6,8 |
| 3° | 6,7 | 6,8 | 7,0 | 7,0 | 6,9 |
| 4° | 6,6 | 6,8 | 7,0 | 7,0 | 6,8 |

\* First half yearly beginning in 08/99

In the Unity Panela river, that had the lowest pH rate, predominate pasture areas with mean to low technical level. These areas do not use limy to correct the soil. In the others Unities predominate annual tillage areas, that use some technical, include the limy, which can be acquired freely in the City Hall. Probably part of the limy used in this areas was carried to the rivers by the erosion process.

The analysis of correlation between the factors presence or absence of surrounding forest, landscape format, use of soil and pH rate in the Unities Planning denoted that amount the surrounding forest as the use of soil are important to explain the pH rates. The Unities that had the highest rates also had the highest values of absence of surrounding forest. Over there, in the manancial area the farmers do not invest in the pasture areas and this receives less limy than the crop areas. The Unities with more crop area also had the high pH rate (Table 5).

**Table 5    Correlation analysis between pH, surrounding forest, soil use and landscape format for the Unities of Planning of manancial area**

| Unity | pH | %presence of surrounding forest | Soil use | Landscape format |
|---|---|---|---|---|
| Panela | 6,7 | 0,543 | 0,477 | 0,001 |
| Mangueirinha | 6,8 | 0,344 | 0,773 | 0,000 |
| Lambedor | 7,0 | 0,667 | 0,245 | 0,134 |
| Pinheiro | 7,0 | 0,667 | 0,321 | 0,028 |
| Conrado | 6,9 | 0,622 | 0,334 | 0,053 |

For turbidity of water (Table 6), the Unity that have most concave landscape also had the highest level of turbidity. Almost do not have differences between the order of predominate of this landscape format and the turbidity rate. The turbidity is a physical parameter, how much high is the turbidity of water, how much high is the rate of solids sediments presents into the water. The correlation between the turbidity, absence of surrounding forest and landscape format, the results show that the surrounding forest is not a important parameter for turbidity, there are no correlation between this parameters, but had with the landscape format. The Unity with smallest rate of absence of surrounding forest had the highest rate of turbidity, the predominate of concave landscape and soil use with annual tillage.

**Table 6    Correlation analysis between turbidity, surrounding forest and landscape format for the Unities of Planning of manancial area**

| Unity | Turbidity\* | %presence of surrounding forest | Landscape format |
|---|---|---|---|
| Panela | 9,5 | 0,043 | 0,922 |
| Mangueirinha | 5,9 | 0,344 | 0,873 |
| Lambedor | 6,4 | 0,167 | 0,870 |
| Pinheiro | 6,6 | 0,267 | 0,330 |
| Conrado | 7,5 | 0,122 | 0,402 |

\* Means of  years 1998, 1999, 2000 – biweekly analysis

The correlation between turbidity, surrounding forest and landscape format explains the turbidity in some case, but many dubieties persist. The results indicate that the combination of factors conduces to the

contamination of water. To explain this case was realized correlation analysis between turbidity, presence of surrounding forest, landscape format and soil use (Table 7).

**Table 7   Correlation analysis between turbidity, surrounding forest, landscape format and soil use for the Unities of Planning of manancial area**

| Unity | Turbidity* | %presence of surrounding forest | Use of soil | Landscape format |
|---|---|---|---|---|
| Panela | 9,5 | 0,043 | 0,120 | 0,822 |
| Mangueirinha | 5,9 | 0,225 | 0,000 | 0,873 |
| Lambedor | 6,4 | 0,167 | 0,130 | 0,670 |
| Pinheiro | 6,6 | 0,120 | 0,550 | 0,330 |
| Conrado | 7,5 | 0,122 | 0,496 | 0,402 |

* Means of years 1998, 1999, 2000 – biweekly analysis

The Unity Pinheiro had more correlation with the kind of soil use than the landscape format, maybe why this Unity had more concave landscape, but are a important part of convex landscape to.

## 4   Conclusion

This results shows that the landscape format is an important factor to understand the process of environmental contamination, specially in areas under annual tillage with a small or very altered surrounding forest, and permit to conclude that the combination between the factors are much more important than the analysis of each one factor. For familiar farms the Brazilian environmental law must be revised, and new recommendation must be prepared considering the format of landscape and kind of soil use, for then to determine the correct breadth of surrounding forest.

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