AMOUNT OF CARBON IN THE SOIL RELATED WITH WATER TURBIDITY OF PANELA AND LAMBEDOR RIVERS

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Abstract
The water quality is important in many countries However, it is important to select indicators that result in necessary information, with low cost and can be used in diverse places. Another important factor is the systemic character of the information. This work was undertaken to evaluate the use of soil in Panela and Lambedor River watersheds, and to verify the potential to use simple indicators that identify appropriate soil management and water qualities. The systems were no tillage (NT), conventional tillage (CT), winter break (WB) and pasture (PA). Soil samples had been taken at a depth of 0-100 mm. With the organic carbon data, a mosaic of values of present organic substance in the ground was constructed border the rivers. The water samples were collected biweekly in four points along the rivers: nascent (NAS), superior average segment (SAS), inferior average segment (IAS), and mouth (EST). The organic carbon was correlated positively with the soil system of use and with the turbidity of the water. The evaluation showed that the amount of stored organic material substance is a function of the soil and influences the turbidity.

Additional Keywords: Organic carbon, turbidity, water quality, soil use.

Introduction
The great use pressure exercised on the soil in small properties it can cause severe degradation of this and consequently of the surface water. The management type checked to the soil of a basin it is preponderant for the sustainability of the agricultural activities in her accomplished as well as of your hydrologic potential. The model of spread development in Brazil starting from the decade of 60 implanted in the agriculture a group of techniques that took the intense use of the lands and contamination of the surface water. In the small agricultural properties, this picture is worsened by the insert of one more factor: the small territorial extension, demanding more intense use of the soil then to stay in the model of dominant development. In most of the cases, this implicates in reduction of the amount of residues left on the soil, so that the amount of present organic matter in the soil is going reducing every agricultural year. With the reduction of the covering of the soil, it becomes more susceptible to the erosive process, contributing more sediment to the courses of water. This work was developed in the years of 2000 and 2001 with the objective of evaluating the use of the soil of the hillsides of the microbasins of the rivers Pinheiro and Lambedor, both flowing of the river Pato Branco in Mariópolis–Paraná, and the modifications of the surface water in some segments of the referred rivers from mountain to the estuary.

Materials and Methods
The soils of this area are derived of the basalt of Trapp, Formation Serra Geral. The predominant soil classes are Nitossolos Vermelhos–Cambissolos Háplicos–Neossolos Litólicos. (Paleudult – Eutrudept -Orthent) rising of the use of the soil and of the management systems it was made being traveled all the agricultural properties that border the rivers Pinheiro and Lambedor. In each property a questionnaire was filled out with the farmer being collected information on the type of adopted management, the time of use of such a handling, adoption or not of techniques of control of the erosion and information on lime and manure use. After the interview with the farmers teams of 4 people traveled the property to collect information on erosion presence, to verify the forms/strategies of control of the erosion adopted in the property, and in the properties in that there was cattle, looking for protection fences to the surrounding forest and points that the animal use to drink river water in the river. With base in the collected information was verified two use types: farming and pasture (PA). In the areas of farming three systems of management of the soil were significant in the properties: no tillage (NT), conventional tillage (CT), and winter break (WB). The last one means the conventional tillage in the summer and the abandonment of the areas in the winter, so, spontaneous plants cover de area. The areas then are distributed among forest areas, farming areas under no tillage, conventional tillage or winter break and pasture areas. In this last category it was just considered the perennial pastures. After, it was collected soil samples in the properties in agreement with the defined areas in function of the type of use of the soil and management system. The samples were collected in the depth from 0 to 100mm. This collect was accomplished twice, being the first in March of 2000 and Monday in June of 2001. The total content of organic carbon of the samples was determined by the Walkley-Black method. With the data of organic carbon a mosaic of values of present organic matter was built in the properties that border the river. The

samples of water were collected biweekly in four points along the two appraised rivers: NAS, UMS, LMS and EST in the period of February of 2000 to December of 2001. Two simple samples were removed in each point and these were directed to the laboratory of SANEPAR for analysis of turbidity, color, consumed oxygen and pH.

Results and Discussion

The table 1 display the results obtained for organic matter in the use systems and management of the soil. The system with larger content of organic matter in the appraised watershed was the NT. This system tends to the accumulation due to the no use of plow in the soil, maintaining the residues in the surface and the adoption of covering plants of the soil during the winter. The best acting of this system, while the expected would be that the pasture areas. Presented better acting in NT probably due the appraised layer. As it was collected from 0 to 100 mm, it is probable that leaves partially of the straw layer decomposed it has been collected, elevating the content of organic carbon. As division of the carbon was not accomplished in none of the appraised systems it is not possible to identify which fraction is participating more of the total volume of carbon of the soil. It is common a increase of the heavy fraction in the system NT, especially in the first years. In this case, it expected the total organic carbon it is composed mainly by the light fraction (particulate organic matter).

Soon after, in accumulation of organic matter, they are the PA. This is probably due the natural tendency of accumulation of organic matter that soils under pasture present, due to the no plowing once in this group they are just the permanent pastures. The species used they are also capable to emit great amount of roots, facilitating the accumulation. The recalcitrance of the organic matter in these systems has been told as higher for several authors, what also explains the acting of these areas. Another important factor is that in most of these areas the capacity is low, due to steepness of the soils, not having therefore pasture consumption above the working power of the same ones. The exception in this case is the nascent of the Pinheiro river, in which happen greater capacities than the others. In the Table 1 is observed that the values of organic matter are smaller in the areas of pasture of the Pinheiro river. The conventional tillage probably presented larger content of organic matter in relation to the winter break due to use of covering plants (mainly oat) that is adopted by the farmers of both watershed. The smallest acting of the conventional planting of the Pinheiro river in relation to the Lambedor river is probably due at the farmers' largest technological level of this last, more familiarized to practices as use of lime and manure application.

Table 1. Organic matter(OM) in the four systems of management of the soil identified in the microbacins of the rivers Pinheiro and Lambedor for the layer from 0 to 100 mm

	1ª evaluation		2ª evaluation	
	OM g.dm^3			
	PR	LR	PR	LR
NT	17.21	20.01	16.10	21.10
CT	09.11	14.19	09.26	12.41
WB	07.34	12.30	09.57	12.79
PA	15.17	16.82	15.53	17.08

In relationship the space distribution of the systems of management of the soil (Table 2), the no tillage prevails in the two watershed, however in the Pinheiro river is going increasing your adoption in the sense of the nascent for the mouth, the measure that reduce the areas under winter break and pasture. This is due the high steepness found in the East of this river, what provides shallow and stony soils, that the farmers find more difficult to maintain under no tillage and these areas are used then for pasture, receiving perennial pasture. Already in the Lambedor river the percentage of adoption of the no tillage stays more constant from the upper to the mouth, and the one that changes is the percentage of conventional tillage, that increases in the LMS in detriment of the pasture. Here also it is possible to identify a common practice in the area: it is used to cultivate areas under pasture for two or three years before entering in the no tillage system when doing the pasture conversion for farming.

Table 2. Spatial distribution of the systems of management of the soil in the four segments of the Lambedor and Pinheiro rivers

	NAS %		UMS %		LMS %		EST %	
	RP	RL	RP	RL	RP	RL	RP	RL
NT	20	45	34	45	43	51	40	53
CT	27	17	26	17	29	27	22	20
WB	18	17	15	17	05	13	13	07
PA	35	21	25	21	23	09	25	20

In the comparison among watershed (Table 3) the basin of the Lambedor river presented better acting for the no tillage in all the segments, for pasture in the NAS, and for winter break in the East and mouth. The difference in the steepness of the two nascent areas influences in the distribution of the soil classes, doing with that in the Lambedor river soils prevail a little deeper that in the Pinheiro river. This factor might also have contributed to the largest accumulation of organic matter, once the heavy fraction associates to the minerals of the soil, especially clay, checking and receiving stability of these elements. This result can also be reflecting the farmers' technological level of Lambedor river, that is larger than the one of the farmers of the watershed of the Pinheiro river.

Table 3. Amount of organic matter in the soil in the four segments of the Lambedor and Pinheiro rivers

	NAS $g.dm^3$		UMS $g.dm^3$		LMS $g.dm^3$		EST $g.dm^3$	
	RP	RL	RP	RL	RP	RL	RP	RL
NT	15,01aB	18,71aA	14,10bB	19,55aA	17,03aB	21,95aA	17,57aB	20,74aA
CT	07,21bC	12,09cB	09,28cC	13,40bB	10,39bC	12,95cC	09,79cC	13,07bB
WB	09,70bC	13,10cB	08,63cC	12,15bC	07,43cC	12,89cC	08,79cC	13,55bB
PA	12,35aB	17,05aA	17,31aA	14,64bB	16,31aB	16,27bB	16,03aB	15,22bB

* small letter differs in the column to 5% for the Tukey test, capital letter differs in the line.

In the Table 3 they are also the medium amount of organic matter for system in the four segments of the two watershed. In all the segments the no tillage differed significantly of the conventional tillage in a same watershed, indicating larger accumulation of organic matter. In relation to the pasture, there was significant difference among the two systems in the segment medium superior of the two watershed, in the segment medium inferior and in the mouth just for the Lambedor river. Being just considered the accumulation of organic matter in the soil, in the two basins the efficiency of the systems follows the same order: direct planting, pasture, conventional planting and with smaller accumulation winter break. The Table 4 presents the data of turbidity of the water. It is noticed that the turbidity of the Pinheiro river is already higher in your nascent. This is due to the fact of it is inside of a pasture area, in which the animals have free access to the river. It is also one of the areas with animal over the pasture production capacity, what worsens the production of sediment. The covering of the soil it is reduced because the forage consumption is larger than the productive potential of the same. This does with that the increment of organic matter is smaller, and consequently the accumulation of carbon, turning the most susceptible soil to the erosive process. Besides, the excess of animals affects other important characteristics, as the macroporosity and the capacity of water infiltration. The roads used by the animals to arrive easily until the river they become erosion furrows. The Lambedor River, to the opposite, has your nascent relatively protected. It is noticed that even with amounts of organic matter that they didn't differ significantly of the no tillage, the production of sediments in pasture areas can be linked the other factors, inexistent in the farming areas. In the upper medium segment (UMS), the increment of sediments is proportionally larger in the Lambedor river that in the Pinheiro river. As there is little variation in the content of organic matter, and there is hardly change in the system of management of the soil, it was ended that the increment represents a punctual source of sediments appeared during the adequation of highways in the watershed.

Table 4. Turbidity of the water in the Pinheiro and Lambedor rivers along the four segments

Segment	Turbidity (NTU)	
	PR	**LR**
NAS	11.7aA *	04.6aB
UMS	15.3bA	08.7bB
LMS	15.7bA	09.0bB
EST	16.8cA	09.8bB

small letter differs in the column to 5% for the Tukey test, capital letter differs in the line.

The increment of sediments of the lower medium segment of the Pinheiro river test of in relation to the upper segment, is practically null, probably due to the increase of the areas under no tillage. Another factor that can be competing is the change of the morphology of the river. Of the upper medium segment, for the mouth, progressively it increases the height of the ravine of the river, this does with that the farmers avoid that the animals have access free to the river to avoid accidents.

Figure 1 displays the correlation analysis between turbidity and organic matter in the soil. High values of organic matter seem to appear for low turbidity, but when the values of organic matter are low, the correlation is not clear. The use systems in that the accumulation of organic matter is smaller, the risk of punctual events that carry sediments inside of the bed it is larger, like this, it is easier to verify the breaking of a level curve for instance, in an area under conventional tillage that in an area under no tillage. These events act in a punctual way, carrying great amounts of sediments that result in high values of turbidity. Another factor to be reminded is that in the areas under pasture, same when there is great stock of organic matter in the soil, they can happen formation of sources of sediments if the animals have free access to the river.

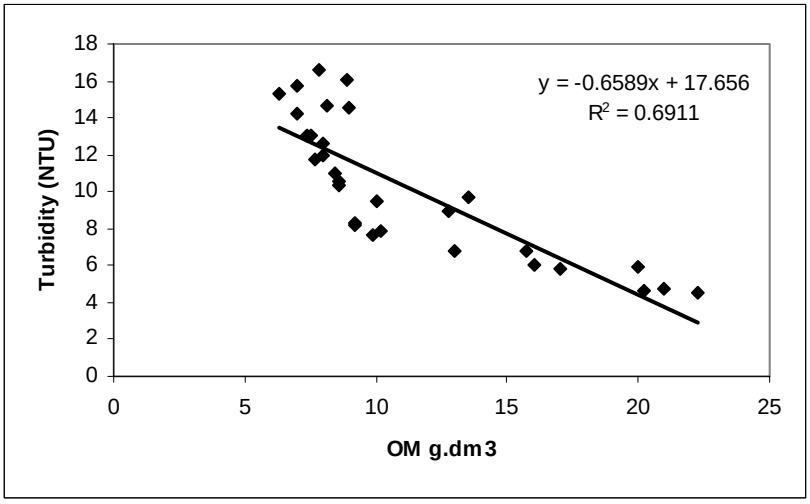

Figure 1. Correlation analysis between turbidity of the water and amount of organic matter of the soil for the Pinheiro and Lambedor Rivers.

Conclusions

With base in the appraised data is ended that the amount of organic matter stored in the soil it influences the turbidity of the water, doing with that this is maintained or reduced in function of the use of the soil. However, punctual sources of sediments can also contribute to the increase of the turbidity, even in areas with high contents of organic matter in the soil. This implies that the margin of safety for this relationship is very small, being just this type of advisable evaluation for small microbacins, in which it is possible to know all the potential sources of sediments.