THE SEDIMENT'S DINAMICS AND THE WATER FLOW VARIATION IN AN URBAN GULLY IN UBERLÂNDIA – MG

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CHARACTERIZATION AND LOCALIZATION OF THE RESEARCH AREA

A gully located in urban area of Uberlândia city - MG had been chosen as a research area. In this city, the gully is located in a district called Jardim Karaíba, which is in Hydrographic Basin of the Lagoinha brook.

Uberlândia is located in a region know as Cerrado (a kind of savanna). This region shown sandy soils in the highest lands and organic soils in the bottom of the valleys (lowest lands), Sandstone of the Marília Formation and Basalts of the Serra Geral Formation, the most part of the vegetal species are grassy and bushs, the climate is the Wet Tropical (CWA, according to Cöpper) which holds a wet and hot season and other dry and with lower temperatures (each season has a duration approximated of 6 months).

The hydrographic basin where is located the studied gully was extremely modified by the action of the Human Kind, and more than 90% of its area had suffered any kind of this modification. So, problems like the rise of the superficial drainage come and cause a lot of erosion problems in the basin. The most part of the vegetation close to the water channels in the basin, had been putted down cause the Human Kind occupation, and with this, the borders of channels become unprotected and the erosion process start to act with high power, as happen in the case of this gully that had being studied (fig. 1).

The studied gully is an amazing example of the results of a bad human intervention in the environment. This gully had the water blooming in the begin of the 90s, and since that time, a lot of intervention had been done in the area, as a variety of earthwork, and other more drastic, like a deviation of the mainly channel in approximately 90° degrees and a part of the pluvial net of the district was directed to the inside part of the channel. The

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new channel has approximately 300 meters of length, and holds a big rupture point in its half, forming a fall with 3 meters of height (a water fall), where the power of the erosion process is more intense.

Fig. 1 – Studied gully. The most part of the vegetation have been putted down in the hydrographic basin. In this area there is a formation of a fall in the mainly gully's channel (ALVES, Ricardo – September 2003).

GENERAL OBJECTIVE

The general objective of this research is to identify and measure a gully's evolution located in urban are according to de flow variation and the variation of suspended and bottom sediments.

SPECIFICS OBJECTIVES

- To measure the water flow of the gully's channel during a period and in predetermined intervals, which is fundamental for determining the erosion intensity of the system.

- To determine the average of the water flow variation;

- To measure the quantity of suspended sediments for making comparisons during de research and to determine the quantity of sediment loss in the system.

- To measure the quantity of sediments that has being transported at the bottom of the channel, which will help to determine the total loss of sediments in the system.

- To determine the size of the soil's particles which has being transported at the bottom of the channel. So, it will be possible to determine the capacity of sediments transport.

METHODOLOGY

For executing this research and the objectifies have been reached, it was necessary to work with data collect referring to the water flow variation, variation of the quantity of suspended sediments, variation of the quantity of sediments transported in the channel's bottom and analyses of the soil's particles size. All of this collect data was done after each 15 days and in two different points along to the gully.

To collect data referring to the water flow variation, it was necessary to develop a device to dam up the water of the channel (fig. 2). In the middle of this device there was a pipe that used to work as floodgate, releasing the water flow according to the rise up of the water level in the dam lake. This device has been made by steel foils, with 1,40cm length, 33cm width and the floodgate pipe with 15cm diameter. These sizes have been defined after a complex study of the points where the data collect would be done. So, a device with these sizes would be used in the two points chosen for doing the collect of the water flow variation.

Fig. 2 – This picture shows the two points of water flow variation data collect. The figure A indicates where was the point 1, which was located before the water fall. The figure B indicates where was the point 2, which was located near of the gully mouth and is indicated by the white arrow. It was used about 25 minutes in each point for installing and starting the process of data collection (ALVES, Ricardo – October 2003).

For collecting the data of the quantity of suspended sediments in the water, it was necessary to use a process of filtration. It was determined two points of data collection where the water was collected. In each point, it was collected four liters of water, which have been sent to the lab where the filtration process were carried out. All the material used in this data collection was composed basically of recipients for collecting, recipients to storage and to transport, funnels, paper filter and a very accurate scale.

The papers filters were scaled before the beginning of the filtration. With the end of water filtration the filters had to dry during 24 hours. After this, the filter where scaled again and the difference between the second and the first weight was the value of the quantity of suspended sediments by four liters of water. After to divide the difference of the paper weight by four liters of water, the quantity of suspended sediments by liter of water had been determined.

The data collect of the sediments transported at the bottom of the channel was done using a sediment trap, which was elaborated for having a better adaptation to the channel bottom and in two different points of data collection, but with almost the same physical characteristics (current, steepness and the width of the channel). The first point was located in the beginning of area with the highest erosive activity and the second one was located near of the gully mouth.

The sediments trap developed was adapted from the models presented by CARVALHO et al (2000) (fig. 3). The adapted trap had 20cm length, 25cm width and 12cm depth. This device was used to collect sediments during 15 minutes. After that, a part of water was drained, and the remaining material (water and sediments) were transported to the lab where the remaining material was dried. After the drying process, the material was scaled in a very accurate scale, and so, the quantities of transported sediments were determined along of an hour, and the result was given in sediments per hour (s/h).

Fig. 3 – Sediment trap installed at the bottom of the gully's channel (ALVES, Ricardo – September 2003)

RESULTS

Water flow variation

The measurement of the water flow variation is very important for studying the sediments dynamics in a channel (in this case, in a gully channel), because the variation of the water flow can also mean the variation of the erosion and sedimentation power along of all the channel (CHRISTOFOLETTI, 1988). For example, if the water flow variation increase considerably, probably will happens a higher detachment of sediments near of the water fall, a lesser sedimentation along to the channel and a higher out put of sediments at the mouth of the gully.

It was noted that the water flow variation at this point was caused by a variation of the sub-superficial watery, by the water which comes from the pluvial net of the Karaíba district and by the rains.

The water flow variation measurement proved that the water flow had a normal variation during the research months (fig. 4), staying at normal value according to the pluviometer data. The total variation at the point 1 was 860ml/s, what represent a difference of 53% between the highest and lowest water flow variation registered. At the second point, the difference between the highest and lowest water flow was 730ml/s, representing a difference of 39%.

The water flow variation between the two points where the measurements were done had stayed in the average, showing normal values according to the natural differences between the two points. The maximum variations reached between the two points were

360ml/s, corresponding a variation of 22%. In the time of this measurement, the water flow were higher at point 2 than point1, what prove that the difference of altitude (3 meters) of each point was enough to increase the water at point 2 due to physical terrain conditions.

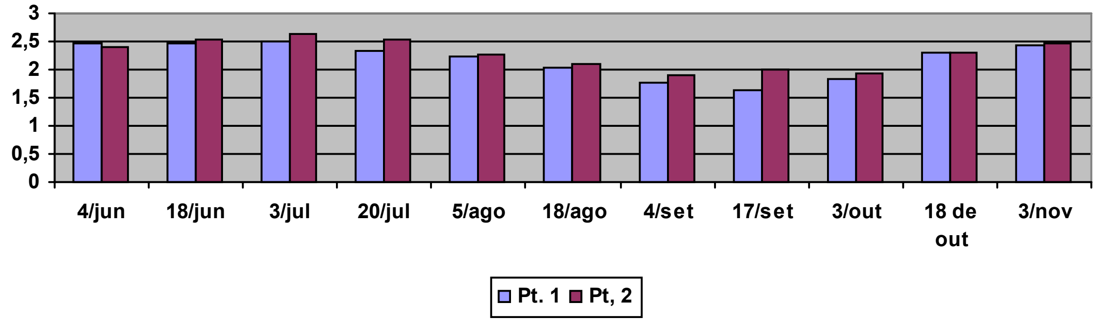

Fig. 4 – This research shows a comparison between the two points of the water flow variation measurement and its variations along to the research time (ALVES, Ricardo – Septermber, 2003).

Suspended sediments

After make a visual analyze of the suspended sediments in the water, it was noted that in more than 90% of the measurement moments, the water was clear and out of sediments, when was possible to see the bottom of the channel along to the its all extension. The suspended sediment concentration was higher and the water used to get the white color when some intervention was done in the channel, which was caused by children or domestic animals.

According to the data collecting, it was observed that the variation of the quantity of suspended sediments in the water under normal conditions of flow had occurred in intensive form. Besides, in 86% of the cases the quantity of suspended sediments by liter of water was lower than 0,030g. However, in three especial cases with intervention on the channel, the index of sediment concentration was very high in comparison of the normal situations (fig. 5).

Under normal conditions of the channel, it means, with no concentrated rains and Human Kind interventions, the average of sediment gram by liter of water was 0,0140g/l at point 1, and at point 2 this value was 0,0156g/l. After a day with a water flow equal to 2L/s, will be found a result of 2419g at point 1 and 2696g at the second point, registering a difference of 277g between each other. The fact of the quantity of sediment be higher at the second point, indicates that the average rate of sedimentation was negative in that moment, represented by a valor of -0,0016g/l, which means that each liter of water used to get the second point with 0,0016g of the sediments (the gully was losing sediment on its mouth).

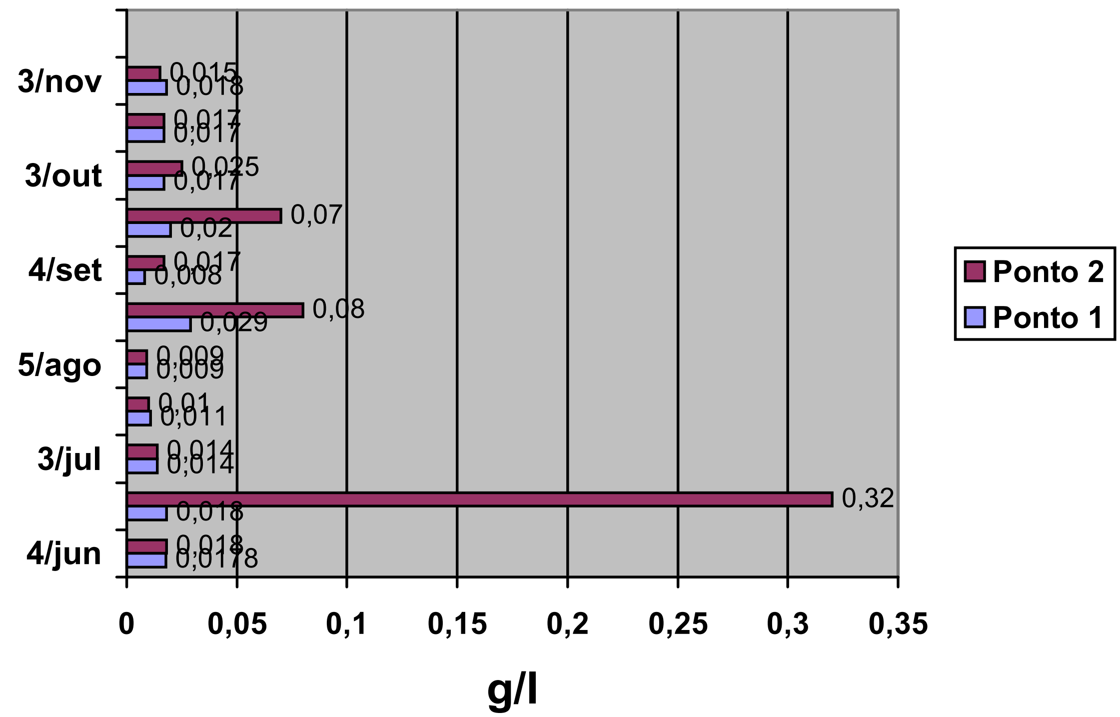

Fig. 5 – This graphic shows the results of the suspended sediments measurements realized during the research, having a quantitative character (ALVES, Ricardo – November, 2003).

Bottom sediments

For collecting the bottom sediments data, it was installed two points of collection where the erosion process used to occur with more intensity. So, the point 1 was installed near of the water fall of the system and the point 2 near of the gully mouth. These points had same physical characteristics, and so, the data were influenced just by the water flow variation or rains.

This method of installation of the data collectors, make possible to work with a data comparison of sediment quantity between the area around the water fall and around the mouth of the gully. It make possible to identify if the quantity of sediments collected at the point 1 was the same of collected at the point 2.

Making an analyze of the collected data under normal conditions of water flow, it will be noted that in the most part of the measurement the point 1 had shown lower quantity of sediments than the point 2 (fig. 6). So, the rate of sedimentation between the points 1 and 2 was lower than the transport, and with this information, it is possible to affirm that the gully channel is an active and direct supplier of sediments to the adjacent hydrographic basin.

During the dry season months, the quantity of transported sediment follow a decline tendency what was considered normal due to the absence of the concentrated rains. After the first rains on september, the decline tendency had been changed, and at the same time, another change happened and was registered a higher quantity of sediments at point 2 than at point 1.

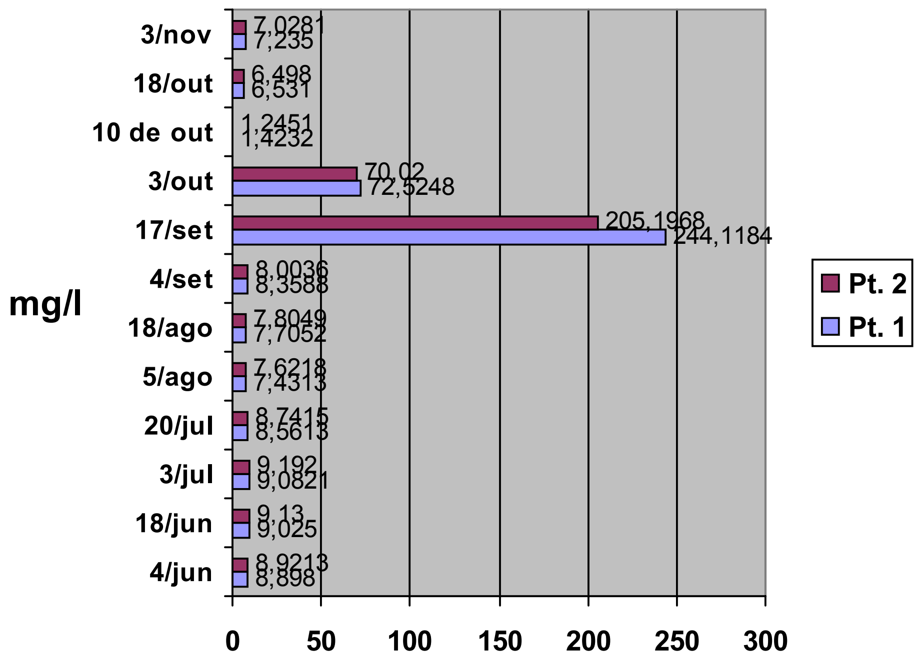

Fig. 6 – This graphic shows that the quantity of sediments was higher in point 1 during all the dry season (ALVES, Ricardo – November, 2003).

CONCLUSIONS

During the research in this gully, a lot of quantitative data related to the sediment dynamics were collected, showing that the erosive process are not just a problem for the place where the erosion processes is occurring, but the erosion could cause others problems to adjacent hydrographic basins.

The researched area is one of the highest supplier of sediment for a brook called Mogi. It is necessary to remember that during all year long there is water into de gully channel (observations done since 2000), what keep a rhythm of sediment supply, of which rhythm is extremely increased during the raining period.

With no Human kind intervention and without rains in gully area, it supply 134,84 grams of sediments in an hour, and the sum of this after a day will be a total of 3,236kg. So, just during the research time (it was about 5 mouths) this gully had supplied 485Kg of sediments to the Mogi Brook, and consequently, to adjacent basins.

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