

# **STUDY OF THE SITUATION OF MASS MOVEMENTS IN THE URBAN AREA OF VIÇOSA (MG)**

Fernando Lucci Resende de Souza

Eliomar Divino de Souza

Patrício A. Silva Carneiro

Aline de Melo Bernardes

Hudson Pocceschi

André Luiz Lopes de Faria

Departamento de Artes e Humanidades, Universidade Federal de Viçosa,  
Viçosa (MG), 36570-000

## **INTRODUCTION**

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The agreement of the relief passes for something more important that the comment of its form, understanding several other factors as climate, soil types and vegetal covering. However, the forms of the relief are inserting as the one of the main components of the environment, being necessary its knowledge for the agreement of the dynamic of the area research object.

This knowledge is indispensable, because it is impossible to repress the occupation expansion of the spaces and much less to restraint environmental impacts caused by the men and the nature is not capable to regenerate all of the damaged spaces in a short space of time. Many of the inhabited spaces are fruits of segregation, which would be consequence of the exclusion that the effective economical system imposes to the people and spaces. On the other hand, the environmental problems are not correlated only with outlying neighborhoods, but they come very visible in places where constructions of high purchasing power prevail. But, one thing we can do is to prevent, the areas that are not busy, because it is viable naturally,

environmentally and less expensive economically speaking. It is in this context, which the study of the mass movements can be of vital importance.

The present work seeks to characterize the mass movements that happen in the urban area of Viçosa, with the objective to relate and to compare the rising done in the urban area of the municipal district at the scale 1: 5000 for Vieira in the year of 2000, in order to verify the evolution of the areas studied by the referred author, being analyzed these progressed or some interventions were suffered.

## **CHARACTERIZATION OF THE AREA**

### The Municipal District of Viçosa

The municipal district of Viçosa-MG is placed to the North of the Area of the Forest of Minas Gerais, in the small area of Viçosa, distance 229 km from the capital Belo Horizonte. It is located among the latitudes from 20°41'20"S to 20°49'35"S and, among the longitudes of 42nd 49'36" W to 42nd 54' 27" W, to a medium altitude of 650 meters, including an area of 300,15 km<sup>2</sup>. The area of Viçosa has a maximum altitude of 960 m and low of 620 m. It presents 85% of mountainous relief, 17% wavy and 3% glide, being drained by basin of Rio Doce. The map below presents the digital model of elevation of the municipal district of Viçosa, detaching the urban area to southeast of the municipal district. (MODEL 3D)

### (MODELO3D)

The municipal district interferes in a prolongation of the Mountain of Mantiqueira, in a division geopolitics denominated as Area of the Forest of Minas Gerais (VALVERDE, 1958). The topography of the area is altered, with narrow and humid valleys and the relief varies of strongly wavy the mountainous (MARISCAL-FLOWERS, 1993).

### The Human Development

The human development in the municipal district is marked by an use and occupation since the time of the mining, in which the area was responsible for the provisioning of agricultural products, as rice, bean, corn and others, for the area of current rich town Ouro

Preto (PANIAGO, 1990). With the fall of the exploration in the cycle of the gold and expropriation of the farms in small properties, the agriculture became just of subsistence.

The beginning of coffee growing in Rio de Janeiro becoming the largest source of income of the municipal district tends peak in the end of the century XIX and the begin of the century XX and went something preponderant for survival of the municipal district. However, with the decadence of the farming's coffee, the city became only source of income, carting great population increase, mainly starting from the half of the century XX.

The urban concentration of Viçosa, as well as of most of the cities at the Area of the Forest in Minas Gerais, was formed initially along the terraces, for a series of factors, as the access easiness, the proximity of the courses of water, the favorable topography, in the form of U open of the valleys of larger order and because it treat of places that didn't flood (QUINTEIRO, 1997. by VIEIRA, 2000). With the population growth, the occupation passed to give in the adjacent areas to the terraces, reaching those leans and the hill tops (VIEIRA, 2000).

According to Ribeiro Filho (1997) that urbanization process of Viçosa, is growing since the decade of 1950 of last century, increasing in the end of the following decade, reaching expressive indexes in the subsequent decades, as demonstrated in the picture to proceed.

PICTURE 01 - Population total, urban and rural of Viçosa (1950-2000).

<b>Decade</b>	<b>Total Population</b>	<b>Urban Population</b>	<b>Rural Population</b>
<b>50</b>	<b>18.325</b>	<b>6.424</b>	<b>11.901</b>
<b>60</b>	<b>21.120</b>	<b>9.342</b>	<b>11.778</b>
<b>70</b>	<b>25.784</b>	<b>17.000</b>	<b>8.784</b>
<b>80</b>	<b>38.655</b>	<b>31.143</b>	<b>7.512</b>
<b>90</b>	<b>55.316</b>	<b>49.320</b>	<b>5.996</b>
<b>00</b>	<b>64.854</b>	<b>59.792</b>	<b>5.062</b>

Origin: IBGE (2003)

This accentuated population growth unchained a series of urban problems in the city, typical of the Brazilian metropolises: slums in areas of hillsides; absence of infrastructures; disordered verticalization, causing densification of the traffic of the city, mainly after the

elevation in the year of 1969 of the Rural University of the State of Minas Gerais, for current Federal University of Viçosa, and a subsequent increment in the real estate speculation with constructions and clandestine and illegal division of lands.

## Soils

In the area, soils of the types LATOSSOLOS AMARELOS prevail in the convex tops; LATOSSOLOS VERMELHOS in the hillsides of the elevations; ARGISSOLOS in the terraces; and NEOSSOLOS associated VERTISSOLOS in the bottoms of the valleys, where they are the larger beds (REZENDE 1971).

According to Azevedo et al., (1998), the main direct consequences of the characteristics of the soils of Viçosa are in the case indeed in the horizon C, for this being easily to erosion, mainly in the building site implantation and of maintenance and implantation of municipal highways and of public roads.

## Climate

According to climatic classification of Köppen, the regional climate is of the type Cwb, humid thermal meso with rainy summers and dry winters (VIANELLO & ALVES, 1991).

The city presents temperature measured annual of 18,5°C, with an average of the low, in the month of July, of 8,2°C, and of the maxims, in the month of February, of 28,5°C. In the autumn, winter and spring happens the predominance of the Atlantic tropical mass and in the winter, mainly, are common the inversions of the Atlantic polar mass, that provokes front rains. The largest incidence of rains happens in the period of October to March, being the pick in December (VIEIRA, 2000).

## Geomorphology

The geomorphology of the area is fruit of a conjugated action of chemical processes and biogenic associated to mechanical processes, resulting in mantle quite altered and thick in the areas of weak steepness to averages (AZEVEDO et al., 1998).

The relief, denominated of seas of hills, where convex-convex and convex-concave slopes aligned prevail in form of ridges, intensely dissected by the fluvial erosion, intermixed by wide valleys of annoying bottom, formed by terraces and larger beds, where there is a little

expressive courses of water, the tops come flat, constituting the divisors of water for the small existent drainage basins (VIEIRA, 2000).

According to Vieira (2000), in the recent conditions of dissecting, the convex-convex landform, that in the past it had the maximum expression, it has been destroyed by the ravines and gullying, developing for a sloping plan, which's the steepness, can vary of fort the soft. The ravines and gullying, according to CÔRREA (1984), it is common in the slopes, mainly in those that already suffered for the indiscriminate deforestation or they are in areas of urban expansion.

## **METHODOLOGY**

The methodology of the present work is summarizes in a selection of points previously lifted up for Vieira (2000). Of the 68 points worked by the author, five were regarding mass movements, which it tries to compare the current apprenticeship of development for the period of 4 years (2000-2004), in order to evaluate the evolution of such process.

The evolution of the movements mass will be evaluated by field visits that will look for to verify in that areas, with base in a summarized model of the field record used by Vieira (2000), in the which will be present the following topics: a) Types of processes - installed or potential; b) Main evidences; c) Main conditions that influences; d) Occupation;

For the elaboration of the digital cartography, it was used the Systems of Geographical Information (SIG's), SIG Arc View, version 3.2 a, being the source base of data supplied by the Laboratory of Geoprocessamento of the Department of Solos/UFV.

## **THEORETIC REFERENCIAL**

Parameters that influence the erosivity of the soils

In agreement with Hudson (1961), by Guerra (2001), the erosivity is the ability of the rain in causing erosion, which should take into account several parameters, turning that very complex theme. Among the parameters to be analyzed, it can stand out: the rain total, the intensity, the moment and the kinetic energy.

The texture influences in the erosion because fractions granule meters are removed more easily than other. A soil that presents a tenor of larger clay offers larger resistance to the processes than one with a larger, same tenor of sand hindering the infiltration of the water.

The organic material (M.O.) is important for working as stabilizer of the attaching which composes certain soil type, and a fall in the index of M.O. will contribute to the intensification of the erosion processes.

The apparent density refers to the largest or smaller compacting of the soil, which can become more resistant to the infiltration of water, turning it more susceptible to the erosion due to the increase of the superficial drainage that compacting promotes. The human action, once again, is an accelerating element of the process and should be considered (intense use in the agriculture, intense mechanization, opening of highways, etc).

The vegetable covering can guarantee a bigger or smaller resistance to the erosion, since it is related with the infiltration of water, stability of the attaching, humus formation, removal of sediments, superficial drainage and in the loss of soils, with it influences varying in agreement with the percentage of this covering.

Characteristics of the hillsides affect the erodibility through the steepness, of the length of the hillside and its form. The steepness, in agreement with the increasing or decreasing, it can guarantee varied infiltration taxes, allied with the vegetable covering, since it can contribute to the variation of the speed of the drainage. The forms of the hillsides can be more important than the steepness, in the erosion of the soils (convex hillsides, with the plane top, they can contribute to the formation of ravines and gullies, when the water stored in this hillside is liberated).

The morphology of the hillside can condition so much in a direct way, as insinuation the occurrence of erosive processes. The direct performance given by the correlation tendency between the steepness of the hillside and the frequency of movements, at long time it was recognized in the measure in that angle of the hillside is increased; it can cause an increase of the risk of sliding.

#### Gravitational movements of mass

The gravitational movements of mass can be classified according to Cunha (1991) in the following way.

Slips: they are processes characterized by fast movements, lateral limits and much defined depths. The main causes of the healthy slips: release and concentration of pluvial waters,

release of served waters, leaks in the net of provisioning of the water, sewage, steepness and excessive height of the cuts, inadequate execution of the embankments, garbage deposition and indiscriminate removal of the vegetable covering.

Falls: they are extremely fast processes that involved blocks and/or chips of rocks in movement of the type free fall. They are conditioned to the presence of rocky blooming in steep hillsides and potentiality by the thermal widths.

Tumbling down: they happen in steep acclivity/acclivity cut of rocks with vertical discontinuities, where the change of the geometry ends up propitiating the tumbling down of the walls of the slope.

Run of mass: those processes are generated starting from a great material contribution for the drainages, which material, combined with a certain volume of water; it ends up forming a viscous mass with high to can destructive and of transport, and with extensive reach ray.

They are caused by indexes exceptional pluviometric, being rarer than the other mass movements, however more destructive.

## **RESULTS AND DISCUSSIONS**

When analyzing the five chosen points for the study it was observed that the processes of mass movements come now in evident evolution in four of the analyzed points, and in just a point an apparent stability exists.

The evolution is verified by the acceleration of the instability process, creating new potential surfaces of rupture, which can be accelerated for the pressure human activity, through building sites.

In the first point the influence was observed for the construction of a gas station carted to the acceleration of the instability at the hillside. In the year of 2000 when the hillside was analyzed, Vieira classified her as prone to the fall of blocks, but no evidenced the process in itself, pointing an inclination of the slope in about 70 degrees, with height of 12 meters, predominance of young residual soil without apparent erosion, not presenting slips.

In 2004, it leans analyzed it presents an evolution in the retreat of materials, fact that can be verified visually and through the employees' of the position reports. The implantation of a wall was verified to contain the descent of materials of the hillside, which present a process of advanced natural disintegration with the exhibition of materials without consolidated (saprolite) and blocks diabase.

The process type installed at the hillside is characterized as process "in potential", in other words, in the limit of occurrence of the sliding with evident fracture in the superior part of the hillside, in agreement with the employee's of the position deposition. The main verified conditioned are: the prominent cut for construction of the position and lack of a system of efficient drainage, since the natural system of drainage was totally modified by the human activity. The occupation of the soil is composed by a commercial establishment in the base of the hillside and for residences in the top.

In the point two, Vieira identified in the hillside, in 2000, intense erosive processes already installed, with slips, resultants of the united performance of several factors, such as: the high inclination of the slope (60 to 70°), retreat of the vegetable covering, height of the slope (45 meters), presenting young and residual soil ripe.

It can be noticed that, in the year of 2004 the processes stayed evident (installed), with acceleration of the movements/slips, intensified by the climatic conditions presented in the beginning of the current year. The conditioners of the processes continue the same ones, in other words, cut improper of the slope, with high inclination and height, as for the human occupation; there was not modification in this factor.

Vieira when analyzing the point three, in the year of 2000, identified the following factors: installed erosive processes evidenced by the intense erosion and slips of horizons. The inclination of the hillside arrives to 60°, with the slope reaching 30 meters of height, with soil characterized as residual ripe, presenting a human occupation in this base, acted by countless residences and commercial establishments.

In the year of 2004, it was observed that the identified processes for Vieira continue prominent and developing. The human occupation turned more intense, worsening the conditions of the analyzed hillside, as well as inclination that increased due excavated earth of the base of the hillside, increase of the built area of the constructions.

In 2000, Vieira analyzing the hillside regarding the point four, observed an apparent stability of the slope, in spite of the erosion presence and slips of horizons. The inclination of the hillside arrives to number of the 70° and this height reaches 15 meters and the soil type was classified as residual young. The human occupation comes so much in the base of the hillside, as in the top, turning the situation of the hillside still more complicated.

In the year of 2004, in a new analyzes, was possible to notice that the hillside still presents certain stabilization, with growth of low vegetation. In spite of that, the erosive processes continue presents, with displacement of saprolites blocks in the base, which can



contribute to aggravation of the situation in the hillside. The human occupation also intensified, with passing of the years.

In the hillside regarding the point five, Vieira didn't identify the erosion presence and slips, in the year of 2000. Referred the hillside presents inclination of 80° and height arriving to 5 meters, presenting stabilization with exposed main rock (amphibolite are and fractured). There is no presence of human occupation. The same stabilization was detected in the year of 2004, in new analyzes. It was possible to observe a good recovery of the local vegetation, what can be contributing to the maintenance of the stability of the hillside.

## **CONCLUSION**

We can approximate to a general approach, which the processes of mass movement identified in the municipal district of Viçosa is in an evolution, mainly starting from the decade of 1970, with the occupation of the low parts towards the tops of the hillsides, owed mainly by the high population number that the city received at the last decades.

Some points are with more accelerated processes due to human activity on the half, which happened due the high value of the urban soil and for this much reduced being in the central places of the city.

When analyzing the five chosen points for the study, it was observed that the human activity is now the largest responsible for the evident evolution of the hillsides with the setting up of erosive processes and mass movements.

We suggested an attendance on the part of the public organs in what refers the application of the legal instruments that can govern the occupation of the urban soil (use law and occupation of the Managing soil-plan). Other suggestion would be accomplishment of educational works with the involved population, through courses and lectures supplied of simplified form, in schools or in the own community, seeking the understanding of the erosive processes and his recognition so that in rain periods the population doesn't come to suffer restrictions.

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