

# THE INTENSIFICATION OF ANTHROPIC PRESSURE THROUGH THE EXPANSION OF THE CONSTRUCTED AREA IN THE SUBCARPATHIAN SECTOR OF THE PRAHOVA VALLEY/ROMANIA (1800-2008)

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## Abstract

The present research focuses on the evolution of anthropic pressure on the environment through the continuous development of the constructed space, in a diachronic comparative analysis of urban-rural environment, detailed on the basis of two characteristic examples: Breaza town and Cornu town. The information resulted from the historical maps was completed by mapping from the ortophotoplans and GPS land surveys. The data base went through statistic differential processes and correlational analysis with the conditions of the physical support, highly important limitations and favorabilities in the assessment of the vulnerability of the Subcarpathian space being revealed.

**Keywords:** *anthropic pressure, constructed area, Prahova Valley, GPS survey*

## Rezumat

*Intensificarea presiunii antropice prin expansiunea spațiului construit în sectorul subcarpatic al văii Prahovei/Romania (1800-2008).* Prezentul studiu se focusează pe evoluția presiunii antropice asupra mediului prin extinderea spațiului construit, printr-o analiză comparativă diacronică a mediului urban și a mediului rural, detaliată în principal prin două exemple caracteristice: orașul Breaza și comuna Cornu. Informațiile rezultate din hărțile istorice au fost completate prin cartările de pe ortofotoplanuri și prin expediții de teren realizate cu GPS-ul. Bazele de date obținute au fost procesate prin metode statistice și prin analize corelative, ținându-se cont de suportul fizico-geografic și factorii constituenți cu cea mai mare importanță în limitarea sau favorizarea vulnerabilității spațiului Subcarpatic analizat.

**Cuvinte-cheie:** *presiune antropică, spațiu construit, valea Prahovei, monitorizare GPS*

## INTRODUCTION

### General data

Ut The Prahova Valley emerges from the mountain sector through the Posada gorge and forms a succession of tectonic-erosive depressions with an accentuated development of the fluvial terraces on 20 kilometres in the Subcarpathian sector, until it reaches the plain sector, near the Câmpina town (Fig. 1 - Right).

The extension of the residential space is mainly favoured in this area by:

- the moderate Subcarpathian climate, with an annual average temperature of 10°C and a degree of insolation similar to the one in the plain area;
- the medium heights of approximate 500 m and the moderate slopes with a North-South direction. Also, the top of the second terrace is 2 kilometres wide in the depression sectors.

These elements are the basis for the development of the constructed space after 1990, a specific phenomenon being the holiday houses that appeared

as a consequence to the degree of accessibility and the proximity to the country capital (about 100 km north of Bucharest).

### Objective

The present research focuses on the evolution of anthropic pressure on the environment through the continuous extension of the constructed space, in a diachronic comparative analysis of urban-rural environment, detailed mainly on the basis of two characteristic examples: Breaza town and Cornu town.

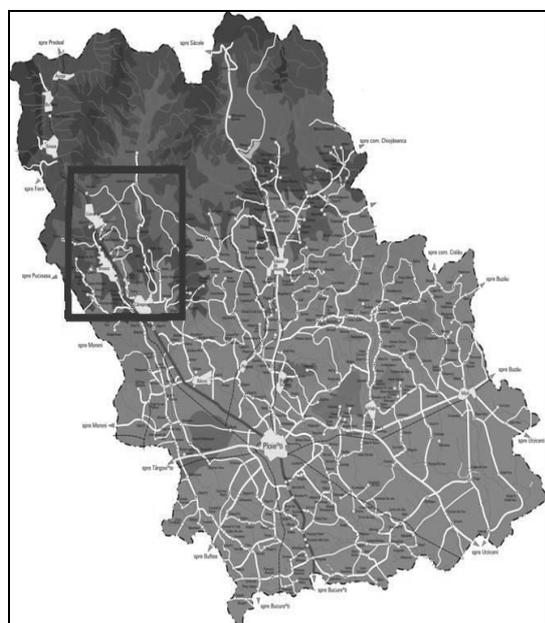
## STUDY AREA

The two settlements under study are located in the Subcarpathian sector of the Prahova catchment area (Fig. 1 - Left).

The studied perimeter represents the western part of the Mio-Pliocene subzone of the Eastern Carpathian Foreland, developed on a subzone of diapire folds. The geological evolution of the area is similar to that of the Dacian Basin, with an initial connection with the Tethys Sea, when there were

accumulated the gypsum and salt deposits during the Lower Miocene (Badenian) age. Beginning with the Lower Pontian, the communication between the eastern and western part of Paratethys, through the

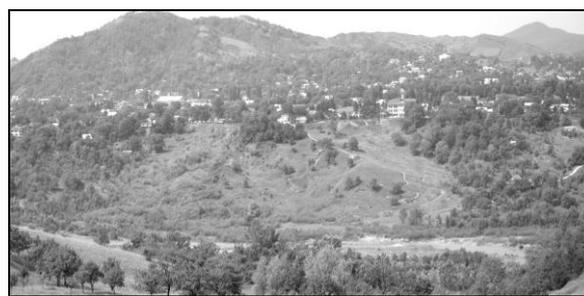
Dacian Basin, is narrowed down to closing, leading to a stage of rhythmic deposits of fine-coarse materials (Armaş et al. 2002).



**Fig. 1 Left - Study area located in the Prahova county; Right - Geographical position of Breaza and Cornu settlements in the Subcarpathian sector of Prahova basin**

**Cornu** town had 4,475 inhabitants in 2002, from which 2,152 are males and 2,323 females and 1,659 buildings in total. In all this buildings, according to the census in 2002, there were 1,860 permanent residences (including 5 spaces used for trading purposes), which includes 5,876 rooms in total (Yearbook, 2003) (Fig. 2 - Left).

**Breaza** town had 18,199 inhabitants in 2002, from which 8,964 are males and 9,235 females. There were 6,078 buildings in total. In all these buildings, according to the census in 2002, there were 7,368 permanent residences (including 46 spaces used for trading purposes), which includes a total of 22,697 rooms (Yearbook, 2003) (Fig. 2 - Right).



**Fig. 2 Left - Terrace plain of Lower Cornu seen from the Plaiu Cornului ridge; Right - General overview over Breaza settlement**

## **METHOD**

One of aspects concerning the anthropogenic impact lies in the continuous expansion in time and space of built domain. To analyze the impact of the process we use the GPS device for the inventory, positioning and mapping of the buildings built in

Breaza locality, in July 2008 (continuing the mapping action started in 2007) and also in Cornu settlement.

Measurements were made with the GPS equipment, using an Garmin76 device type.

During this field investigation we sought to update the database referring to the evolution of the built space in the southern part of the city, and then from the northern extension and from isolated neighborhoods of the city east of DN 1 (Nistorești, Frășinet).

It was found that in this area there are 3 main categories of buildings, similar to those from the previous mapping stage:

Category 1 - new buildings;

Category 2 - old buildings with ground floor, but renovated;

Category 3 - old buildings with ground floor and one or even two new added levels.

The third category includes the old buildings with new added levels that also have the ground floor of the building renovated. The transposition of measurements in the GIS environment has been achieved by the vector type themes layer of information, differentiated on stages of building construction, having as cartographic support for guidance the orthophotoplan in Stereo 70 projection.

Layer type themes of information created in GIS are: "*the area built until 1970*", "*the area built until 2003*", "*the construction after 2003*". The projection used for these themes is Stereo 70.

All the points raised in the field using the GPS in geographical coordinates represent the position of each construction, to which we made a series of observations regarding the components that create a pressure on the substrate. We noted the information relating to the height of the building, the structure of the materials used, the type of property, utilities and considerations on the degree of compaction for the area where the building is located (Tab. 1).

All this information has been linked with the reality from the field by exact note of the address (street and no.), and using GIS environment by automate assignment of an unique serial number made by the GPS for each point marked in the field and accompanied by a set of geographical coordinates. The database was updated based on the points with the tables of attributes raised with the GPS, to each point marked being added a description according to an unique table of attributes.

**Table 1**

Settlement	TOTAL	type of property		material used for construction			high regime				utilities			degree of tightness	
		public	private	wood+glass	brick	mixt*	1 level	2 levels	3 levels	other	water supply	gas	sewage	yes	no
<b>BREAZA</b>	488	7	481	10	160	318	270	201	11	6	316	401	180	417	71
<b>CORNU</b>	307	3	304	25	222	60	204	96	4	3	251	264	85	294	13

\*Mixt= CAC+Brick, CAC+Wood or Brick+Wood

## ANALYSIS

The new buildings are located especially in the hilly area of the city, with a higher density in Breaza de Jos and in the northern extremity. In this area the Breaza town has a diffuse structure regarding the distribution of the newly constructed buildings (Fig. 4). The streets are very irregular and have a pavement of concrete slabs placed transversally on the road axis, with a big influence on the drainage direction of the rain water and washed alluvia.

The representative streets mapped for this type of construction are Poenița Street, Putna Street, Coștila Street, Rășărit Street, Oituz Street, Sunătoarea Street, Tineretului Street (Fig. 5).

The buildings from the 2<sup>nd</sup> and 3<sup>rd</sup> category are most common in the northern extremity of the town, on the terrace scarp (in this area the town has a linear structure) as most of the buildings in Cornu. The buildings, because the material they are made of have a high potential to trigger the phenomena with a geomorphologic risk, but their difficult location (difficult access, etc.) determine a small number of buildings of this type (Fig. 3). The representative streets mapped for this type of constructions are: Piatra Arsă Street, Sulfinelor Street, Dunărea Street, Colin Street, Rugului Street, Panslelor Street, Porumbari Street, Micșunele Street, Fagului Street, Cerbului Street (Fig. 6).



Fig. 3 New buildings in Cornu settlement

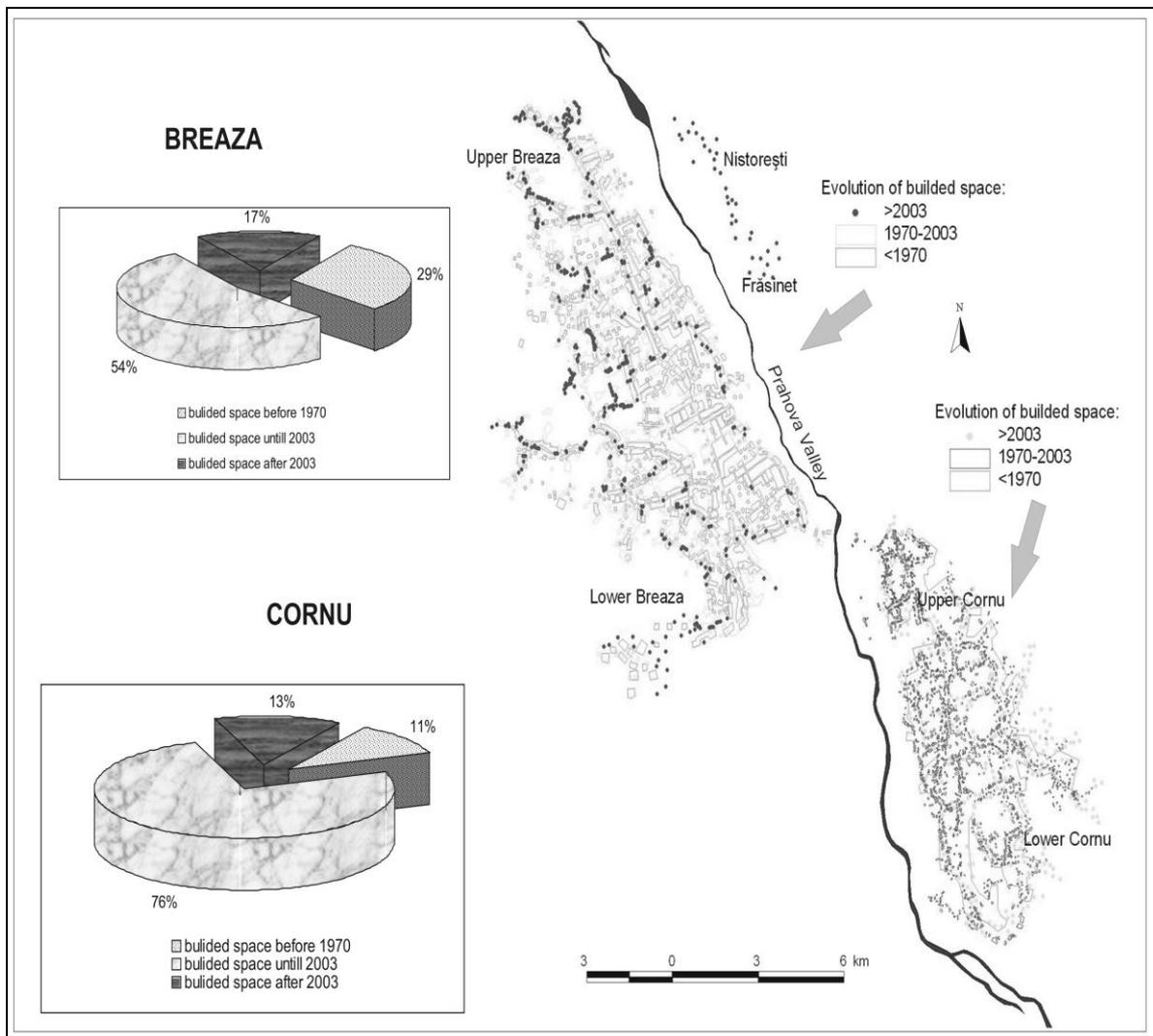
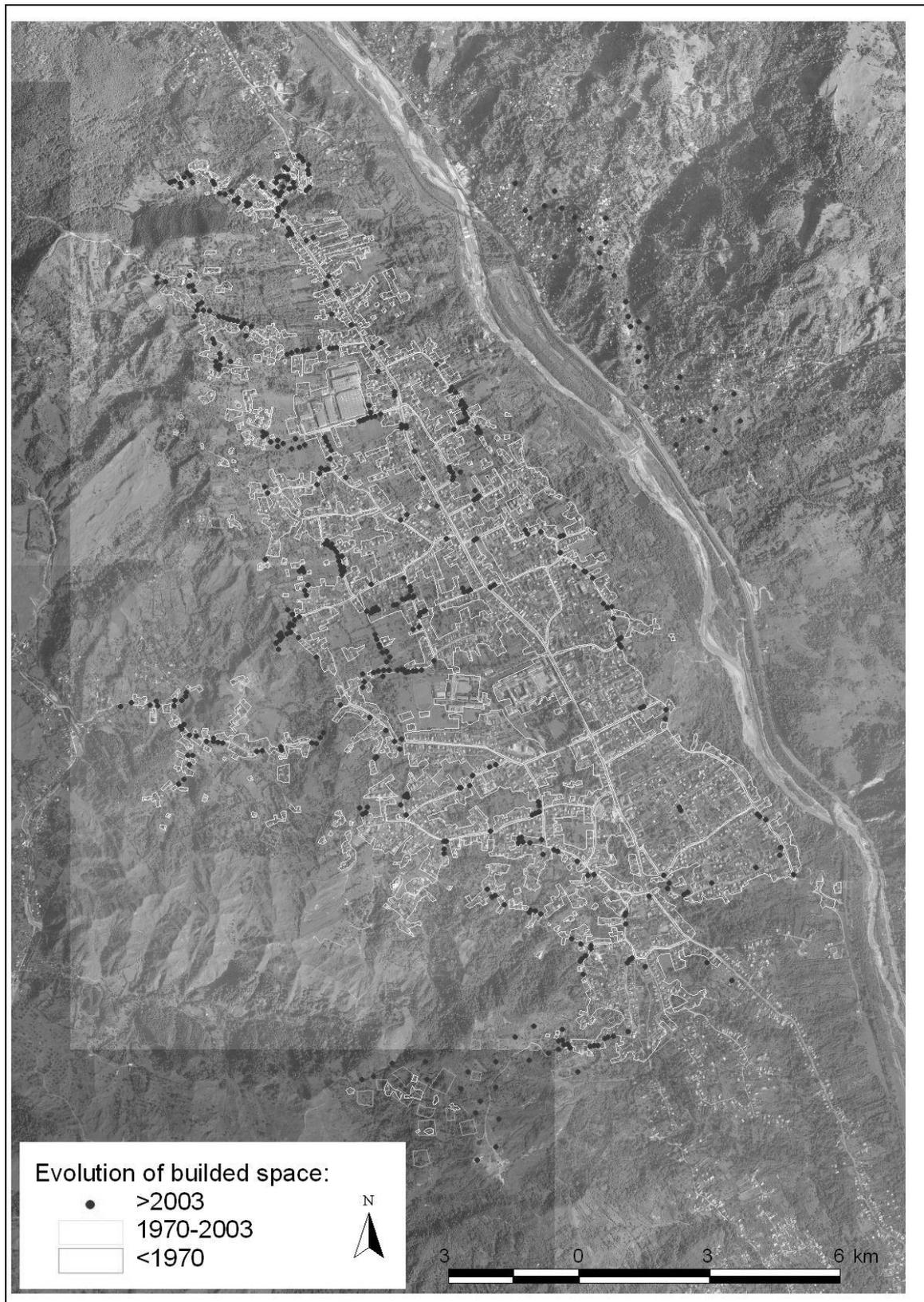


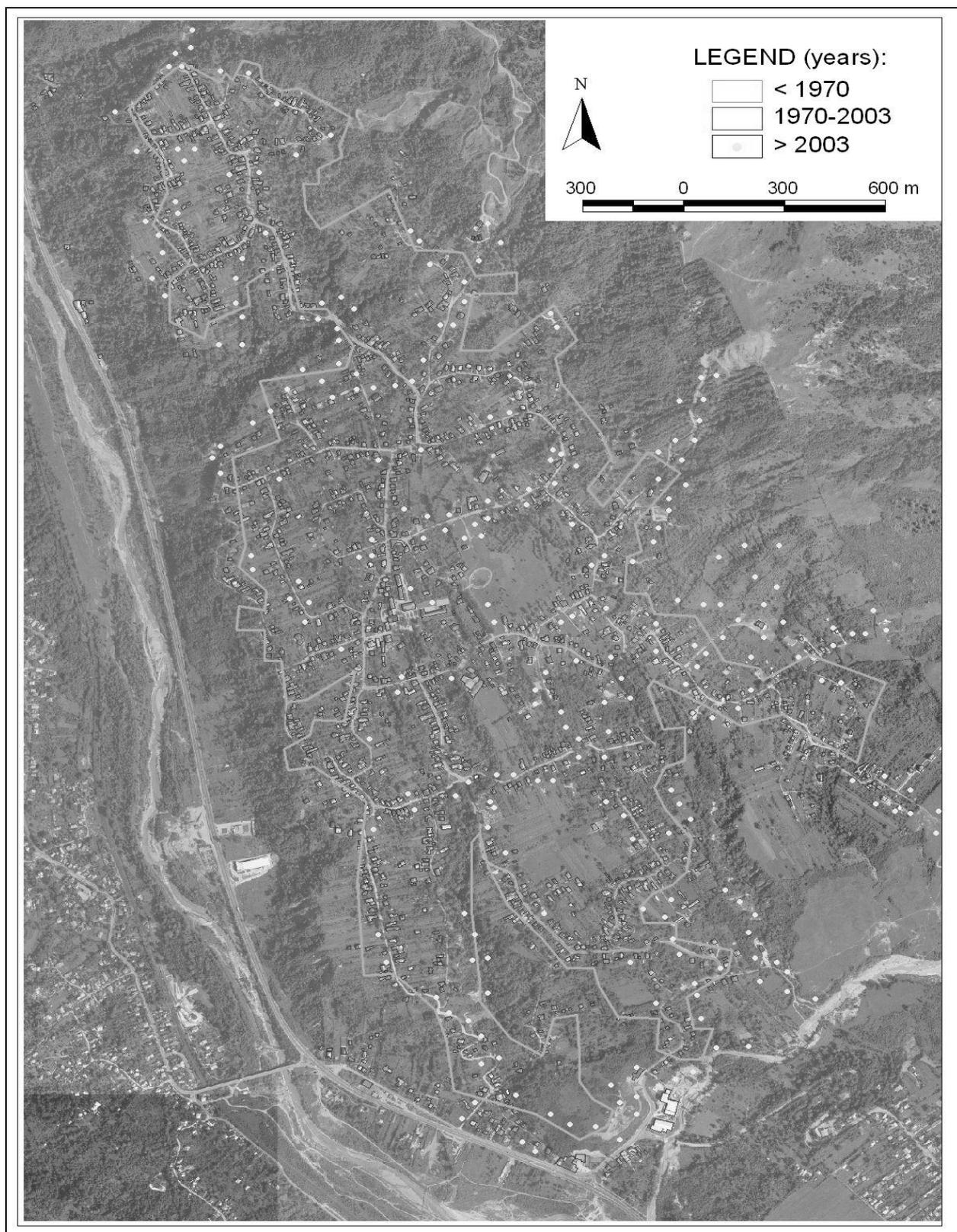
Fig. 4 Comparative situation between Breaza and Cornu

The buildings in 3<sup>rd</sup> category are widespread in particular on the top of the terrace, in the middle part of the town, along Liberty Street, where we note the rectangular type structure. The streets having a great number of this type of buildings are

Saturn Street, Aurora Street, Moldavia Street, Wallachia Street, Banat Street, Sunătorii Street and the streets in the neighborhoods of Nistorești and Frăsinet.



**Fig. 5** The evolution of the space built in BREAZA town (processed orthophotoplan image)



**Fig. 6** The evolution of the space built in CORNU settlement (processed orthophotoplan image)

## MORPHODYNAMIC AND ANTHROPOGENIC IMPACT

In the perimeter of Breaza town, field observations made during a period of more than five years have shown specific morphodynamics aspects. Bodies of rocks are marked by creep processes on the active slopes, and in the slide mass by the appearance of transversal cracks, parallel to the ravines (Mihai Parichi et al. 2008).

Landslides have a specific operation in the neighborhood of constructed areas. In the southern sector, under the Cross from Breaza town, the landslides are more profound on the face of the layers. In the northern sector (the north flank of the syncline, where the Brebu conglomerates appear), on the slope towards the Prahova river the landslides are superficial, stabilized, drained, the predominant specific process is surface wash. A single landslide is mapped in this area, being man induced by opening a quarry (Armaș et al. 2003).

The slope of the II terrace is fragmented into a sequence of small sliding basins arranged in the shape of an amphitheater, with steps and waves corresponding to different generations of landslides.

The studies and researchers in the field led to the conclusion that landslides generally have small and medium depths, with damage to the soil and to a superficial part of the base rock. The trigger factor is represented by the infiltration of rain water into the terrace material and lithological interfaces, a phenomenon correctly perceived by the locals living in the sectors with landslides (Arnas, 2006). Rain waters infiltrate into the deposits of gravels and

outburst above the ground as springs in the slope of the II<sup>nd</sup> terrace. Because of this landslide occur at the limit of the bridge, continuously undermining the edge. In the case of colluvial-proluvial glacia located at the base of the upper terraces (III and IV), is maintained an excessive humidity, favouring the dynamic of the slope. The geomorphological analyses are sustained by the observations and soil mapping carried out in the summer of 2006.

The risk to landslides is important, as people constructed a lot on the slope during the past 15-25 years, as a result of new financial opportunities and land and cadastral availability. There appeared numerous large "holiday houses", with one-two levels, some of them having the ground floor partially buried into the slope.

For new constructions, the issue regarding the foundation was not properly approached, there had not been performed any studies regarding the loading of the slope with the respective constructions, with waste materials, as well as studies concerning the taking over and drainage of rain and sewerage waters (improper sewage networks, septic tank etc.). Constructing these buildings - located on the edge of the terrace and/or "cut" into the slope, as well as all trenches performed for foundations/ walls and underground laying of cables and pipes – represented the cause induced by the human action that favoured the landslides occurred in 1992, 1997 and those from the autumn of 2005 and the summer of 2008 in Cornu settlement (figure 7).



**Fig. 7 Recent landslides in Cornu settlement (stage in 2008 - left; stage in 2009 - right)**

The increased interest in creating residential spaces has not been in direct relationship with the road systematization, problems caused by the type and intensity of traffic and vehicle weight. In this respect, an example is Căproiu Miron Street, a non-standard sized road, without infrastructure and

drainage systems, which follows the edge of the slope toward the Prahova river and which is unrestricted exploited. There are some limitations after the occurrence of the landslides in September 2005 (Armaș et al., 2004).

## CONCLUSIONS

The data bases processed using statistic methods and correlative analyses, taking into account the physical and geographical support and the component factors having a high importance in the limitation or favour of the vulnerability of the analysed Subcarpathian space.

In this study area, represented by Breaza and Cornu settlements, there had been identified three main categories of buildings: category 1 - new buildings; category 2 - old buildings with ground floor, but renovated; and category 3 - old buildings with ground floor and one two levels newly added.

Analysing these three categories of buildings we noticed the influence of the landscape, alongside with the economic factor, in the spatial distribution. So, buildings from the 3<sup>rd</sup> category are particularly spread on the top of the II<sup>nd</sup> terrace of the Prahova river, in both cases (Breaza and Cornu). That indicates the oldest space occupied by these settlements.

Buildings from the 1<sup>st</sup> category are spread, in both cases, in the peripheral area, in the hilly area and rarely in the terraces area. These buildings represent only 17% from all the buildings in Breaza and 13% in Cornu, this area being constructed after 2003.

As a consequence, in both cases, the risk to landslides is highly important, being in the same time a result of new financial opportunities and cadastral changes in the land administration.

## REFERENCES

- Armas, Iuliana, Damian, R., (2002), *Modelul alunecărilor de teren de pe fruntea terasei Breaza*, Lucrările seminarului geografic "Dimitrie Cantemir", Ediția a XXI-a, Iași, nr. 21-22/2001-2002, 23 - 33.
- Armaș, Iuliana, Damian, R., Șandric, I., Osaci-Costache, Gabriela, (2003), *Vulnerabilitatea versanților la alunecări de teren în sectorul subcarpat al văii Prahova*, Ed. Fundației România de Mâine, București.
- Armaș, Iuliana, Damian, R., Sandric, I., (2004), *Landslides in the M. Caproiu St.- Eternității St. perimeter, town of Breaza (Complexul alunecărilor de teren din arealul str. Miron Căproiu-str. Eternității, orașul Breaza)*, Geomorphological Magazine VI, București.
- Armaș, Iuliana, (2006), *Risc și vulnerabilitate. Metode de evaluare în geomorfologie*, Editura Universității din București, București.
- Parichi, M., Armaș, Iuliana, Vartolomei, Florin, (2008), *Evidențierea susceptibilității versanților la alunecări prin studii pedologice. Studiu de caz - orașul Breaza (Valea Prahovei)*, în *Lucrări și rapoarte de cercetare*, vol. 2, Editura Universității din București, pp. 15-28, București.
- \* \* \* (2003), *Yearbook of Population*, Statistical National Institute, Bucharest.