

## THE EVALUATION OF THE RADIOACTIVITY OF THE AGRICULTURAL LAND FROM THE BĂIȚA – BEIUȘ AREA

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### Abstract

*The agricultural land from Băița – Beiuș area are fragmented in small and very small plots of land and the agricultural crops, even if they are not spread over large areas of land, are variously represented. In the Băița – Beiuș area people cultivate corn, wheat, potatoes, vegetables in greenhouses for self consumption or they used to sale the crops in the markets from Ștei, Beiuș or Vașcău.*

*As a result of the primary extraction and processing of the uranium ore from the former uranium mining operation (an activity that took place over several decades), there appeared tailings dumps and depleted ore totaling a volume of approximately 2000000m<sup>3</sup> organized on an area of 1250000m<sup>2</sup>, mine mouths, mine waters and those that wash and / or drain the tailings dumps, dust from dumps entangled by air movements. These represent a potential source of radioactive pollution for the agricultural land, for the plant and animal biodiversity, as well as for the human community in the Băița - Beiuș area.*

*There are radioactive elements in concentrations of the order of ppm, in all the types of rock and in all the types of soil which influence to a greater or lesser extent the evolution and growth of crop plants, spontaneous vegetation. They reach the body of both animals and people.*

**Key words :** radioactivity, radioactive waste, radiations, dumps, agricultural crops, agricultural lands.

### INTRODUCTION

The research aims to perform measurements on the level of radioactivity of agricultural land in different areas, in the Băița - Beiuș area, for a period of 2 years during which the research was carried out (2018 - 2019).

Accepting this space as part of the great geographical unit of the Crișurilor Plain having as limits: - in the North, the Someș Plain; - in the South, the Banat Plain; - in the West, the conventional border with Hungary and further on the great geographical unit of the Pannonian Plain; - the Eastern limit is closed by the Bihor mountain massifs: Vlădeasa which embraces this lagoon with the Pădurea Craiului Mountain range to the North and the Codru Moma Mountains to the South. (Posea, 1997)



Fig. 1. Beiuș Basin (according to Google maps 2019)

„Pollution, direct or indirect introduction, as a result of natural phenomena or human actions, of solids, liquids and vapors or forms of energy (ionizing electromagnetic radiation, heat, sound or vibration) may have harmful effects on human health, on the quality of aquatic or terrestrial ecosystems which may cause damage to property, or which may cause damage or interfere with the comfort or legal use of the environment. When substances that alter the properties or initial characteristics of environmental factors are unstable isotopes, the pollution is called radioactive pollution.” (Directive 60/2000 / EC of the European Parliament and of the Council)

The property of some nuclei to emit  $\alpha$ ,  $\beta$  particles and  $\gamma$  radiation spontaneously without external intervention is called radioactivity. The process is known as radioactive decay and that element is also called a radionuclide or radioisotope. (Mocanu, 1991)

The sources of radioactive pollution in the Băița - Beiuș area are represented by the mining mouths and by the tailings dumps resulting from the processes of extraction, primary processing, crushing, sorting, transport and storage, deposition of radioactive dust and aerosols. But it is important to mention that these sources are in fact potential sources of radioactive pollution, they can become major sources of pollution in case of accidents for agro-ecosystems and environmental factors in the vicinity of the perimeter of the former uranium mining. (Dalea, 2000)

The topicality of this issue results from the existence of possibilities of risks of radioactive pollution, from the surface proposed for research in the Băița - Beiuș area, environmental factors, plant and animal biodiversity, as well as the human factor, due to the existence of tailings dumps and mining mouths from the former uranium mining operation EM Băița. (Dalea, 2004)

In the Băița area, Bihor county, the largest uranium mining operation in Romania had taken place for several decades. Other uranium areas of

national importance are: Ciudanovița - Banat, Stulpicani, Leșu Ursului - Suceava.

Pedogenesis takes place in the South-East area of the Beiuș Basin in a specific way in which the presence of relief, meteorological and anthropogenic elements equally influences and strongly affects the solification process. (Brejea, 2010)

The development and the dynamic evolution of the Crișurilor Plain in the S-E area of the Bihor county, the upper and middle course of the Crișul Negru sub-basin have different characteristics in which we distinguish the Piedmont area where it develops as a narrow strip influenced by exposure and steeper landforms. This specific feature is lost in the Beiuș Basin, where it is replaced by the hilly structure specific to the glacial plain. All this geomorphology in which the elements of high mountainous relief and high plain intertwine determines the existence of mosaic areas of soil types.



Fig. 2. South – East of the Beiuș Basin (2019)

## **MATERIAL AND METHOD**

The research methods consisted of: field observations, discussions with landowners and owners, consultation of archived documents, discussions with local government staff in the Băița – Beiuș area, field measurements, sampling and analysis of soil samples in the laboratory.

The samples for soil samples were taken with the pedological probe from land areas in the Băița – Beiuș area, the analyzes were performed in the laboratories of the Faculty of Environmental Protection in Oradea, at OSPA Oradea, Environmental Guard, CNU and IFIN-HH.



Fig. 3. Pedological probe

Radionuclides determined in the soil samples by spectrometry range  $U_{238}$ ,  $Ra_{226}$ . Sample weight:  $\sim 30\text{--}200$  g (solid samples).

**The description of the method Spectrometry range** is a nuclear technique used in the analysis of the gamma-emitting radionuclides, which are present in different types of samples.

Analytical stages : - identification of radionuclides (qualitative analysis); - determination of the specific activity / activity of radionuclides, expressed in Bq, Bq / kg or Bq / l (quantitative analysis).

**Analysis of natural radioactivity in environmental samples by low background gamma spectrometry** - the gamma spectrum of the natural background in the laboratory is mainly due to radionuclides in the radioactive series uranium-radio ( $U_{238}$ -  $Ra_{226}$ ) and thorium ( $Th_{232}$ ), as well as radionuclide  $K_{40}$ .

The relatively large random temporal variations of radon in the spectrum of the natural background in the laboratory require the alternative measurement of samples and background, especially in the case of samples with low levels of natural radioactivity. The measurement time, for samples and natural background, is about 24 hours. To determine the radon, the samples are sealed and measured after 3-4 weeks to achieve the radioactive balance between  $Ra_{226}$  and its gaseous descendant  $Rn_{222}$  (radon). Gamma spectrometry measures  $Pb_{214}$  and  $Bi_{214}$ , radionuclides descendants of radon. U, Th and K concentrations in the samples can be determined by measuring the radioactivity of uranium ( $U_{238}$ ), thorium ( $Th_{232}$ ) and potassium ( $K_{40}$ ).

## RESULTS AND DISCUSSION

The soil samples from the agricultural lands, in the years 2018-2019, from the Băița - Beiuș area were taken from the arable layer of 0-50 cm and analyzed by gamma spectrometry.

*Table 1*

Content of  $U_{238}$  in the soil samples from agricultural lands between 2018 and 2019 in the Băița-Beiuș area

Crt. No.	Sample location	$U_{238}$ Bq/Kg 2018	$U_{238}$ Bq/Kg 2019
1	Băița Plai - Barieră	321	308
2	Nucet	40	41
3	Câmpani	33	27
4	Ștei next to Moara 4	38	44
5	Beiuș	10	10

*Table 2*

Content of  $Ra_{226}$  in the soil samples from agricultural lands between 2018 and 2019 in the Băița-Beiuș area

Crt. No.	Sample location	$Ra_{226}$ Bq/Kg 2018	$Ra_{226}$ Bq/Kg 2019
1	Băița Plai - Barieră	321	308
2	Nucet	40	41
3	Câmpani	33	27
4	Ștei next to Moara 4	38	44
5	Beiuș	10	10

Please note that the reference values for the content of  $Ra_{226}$  are in the range : - 10 - 60 Bq / kg for sediment samples; - 10 - 40 Bq / kg for soil samples; - 20 - 150 Bq / kg for vegetation samples.

The results show that the environmental radiological danger in the Băița – Beiuș area, resulting from the measurements performed in the period 2018-2019 in the soil samples, does not exceed the reference threshold allowed at national and global level. It can be concluded that the study area is safe for population, agriculture and any other purposes.

## CONCLUSIONS

Waste dumps, mining mouths, air-suspended particles, precipitation that washes and / or drains tailings dumps from the mining perimeter can be sources of radioactive pollution for agricultural land, spontaneous vegetation, agricultural crops, animals and man, from the Băița – Beiuș area.

Global and local weather and climate phenomena influence soil quality indicators and the migration of natural radionuclides into the deep layers of the soil.

The measurements regarding the radioactivity performed for the soil samples, by gamma spectrometry, from the Băița - Beiuș area showed a higher level than the national average of the values for the radioactive

elements  $U_{238}$  and  $Ra_{226}$ , but they are not values that exceed the reference threshold.

It is recommended to monitor and perform measurements with a frequency of at least monthly, or with a higher frequency in the event of undesirable events, regarding the presence of radioactive elements in environmental factors.

The results show that the environmental radiological danger in the Băița – Beiuș area resulting from the analysis of the soil samples performed, have values lower than the value allowed at national and global level. It can be concluded that the study area is safe for the population, agriculture and any other activities or purposes.

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