CONTRIBUTIONS REGARDING AERIAL SCANNING FOR THE CREATION OF A GEOGRAPHIC INFORMATION SYSTEM FOR THE SUSTAINABLE MANAGEMENT OF ENDOGENOUS RESOURCES IN THE CÂRȚIȘOARA TERRITORIAL ADMINISTRATIVE UNIT, SIBIU COUNTY

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***Abstract*:** In the current context of awareness of the limited nature of resources, the development of the rural economy is based on the efficiency of each economic activity. This requires the collection, analysis and processing of a very large volume of data and information in a very short time to increase the degree of knowledge of each identified decision-making problem and to reduce risky decision-making situations and uncertainty. The paper addresses a special category of decision support systems, namely geographic information systems. Concretely, the design elements of a geographic information system are presented for the integration of complex information necessary for the sustainable and efficient organization and management of natural and human resources in Cârtișoara UAT, Sibiu County.

***Key words**: certainty, decision, management.*

INTRODUCTION

The development of a territory/zone/area represents the capitalization in superior conditions of the endogenous resources that give it specificity. Endogenous resources are the basis of the territorial specificity of an area and underpin its development. According to the studies carried out by numerous researchers[8, 11, 12], the process of endogenous development is based on investments in human capital, and the implications of this process are local actors (organizations, institutions, etc.) and the following categories of resources: natural (land, water, climate, ecosystem, fauna, flora); human (knowledge and cognition, experience and expertise); materials (physical infrastructure, schools, hospitals, irrigation systems, etc.); economic (work, the goods market, property, food, prices, credit system, etc.); social (households, social institutions, ethnic organizations, leadership); cultural and spiritual (festivals, rituals, art, lifestyle, language). Any territory has several characteristics that give it individuality, specificity, and authenticity that must be developed and exploited sustainably, to keep them unaltered [4]. During the conference with the theme "Contributions regarding the reform of the Common Agricultural Policy," the idea that the development of the rural area must be adapted to the local specificity, and the competitiveness must also extend to the regional, respectively local level, was detached. The entrepreneurial phenomenon is very important in modern society, and it develops complex processes to create an adequate framework for the promotion of entrepreneurship at the level of all sectors of activity. The level of development of entrepreneurship in a society depends on the importance that state institutions give to this phenomenon, on their ability to promote and implement relevant strategies in a sustainable way, as well as on the willingness to "effort" of entrepreneurs (entrepreneurs). Nations with a well-represented entrepreneurship manage to offer their citizens good living conditions, respectively well-being. This is the reason why every nation must orient the legislative apparatus towards the elaboration of laws, programs, and strategies aimed at encouraging the initiation, operation, and development of businesses, respectively of SMEs. Of course, to achieve this desire, resources are needed, a category where, alongside the material, financial, and human ones, we emphasize for the contemporary economy the essential role of knowledge (information), the only ones capable of orienting the work process towards "intellectualization with an emphasis on creativity" [14]. The current competitive environment highlights the correlation between company performance and the quality of decisions. Making optimal decisions requires fast and effective access to a large volume of information and an efficient process of analyzing it. The multitude of information that can be collected in a short time using various modern means calls for a quick analysis of them that turns out to be beyond human limits, thus requiring the use of processing methods and information technology.

The collection of a very large volume of data and information concerning territorial resources is carried out today on a large scale with the help of UAV systems (unmanned aerial vehicles). They aim at multiple services that have as their common point the technique of terrestrial measurements using emerging technologies [5]. The first uses of drones in civilian applications were made by Yamaha Motor Company (Japan, 1987) through the RMAX-R50 concept dedicated to spraying rice crops with pesticides [17]. Currently, aerial monitoring of ecosystems provides, according to the image processing with dedicated software, real-time information that leads to the early detection of vulnerabilities and the adoption of relevant and effective solutions. [2]. Current research reveals a series of soil mapping methods based on the theory of the soil-landscape relationship [3], respectively on geo-statistical factors [10]; creation and use of neural network based on remote sensing data [19]; making regression models between the reflected spectrum and the percentage content of sand or clay [9]; using microwave remote sensing of soil moisture [13]; evaluation methods soil texture by studying the relationships between the content and size of different soil particle fractions and its surface temperature using predictive linear regression models [15]. Drones have been used in 3D surveying missions and are excellent robots for farms, offering capabilities for monitoring irrigation equipment and its operation mode, highlighting the need for maintenance. Another related mission concerns the surveillance of water resources for irrigation [1]. The multitude of applications of UAV systems lead to the accumulation of a very large volume of data and information that requires storage and processing for the rapid identification of decision alternatives, the assessment of consequences and the choice of the most suitable ones. This requires the design and implementation of decision support systems, among which we emphasize geographic information systems, systems that allow the definition and use of thematic maps that facilitate multicriteria analysis. GIS techniques allow the combination of information of different types, hardware and software components, all under the direct coordination and determination of the human component [16]. Their scope and broad applicability highlighted the need to standardize and interconnect work methods.

The case trial took place in the administrative-territorial unit (UAT) Cârțișoara. It is located in the south-eastern part of Sibiu county, at the foot of the mountains: Arpășel, Bâlea, Valea Doamnei, and Laita having the following geographical coordinates: 45°40′34″N 24°34′36″E.

MATERIALS AND METHODS

The purpose of the work is represented by the knowledge of aerial scanning equipment and UAV systems, respectively its use in the data collection process to create a database corresponding to the current requirements of sustainable development of the territory. The research methodology adopted is the case study because it involves the in-depth study of the rural economy, in the natural framework of the commune of Cârtisoara, from several perspectives [6]. The case study provides a complete illustration of the analyzed phenomenon [18]. Concretely, within the framework of the research methodology, quantitative and qualitative methods were used "in a parallel and complementary way [7, such as secondary analysis of specialized literature and documentation at the Cârțișoara town hall to identify the objective of interest, such as and at the Cadastre and Real Estate Advertising Office, Sibiu. They provided relevant information, but to create a GIS database, we proceeded to use specific scanning equipment.

The application of the research methodology took place according to the schematic structure shown in figure 1.

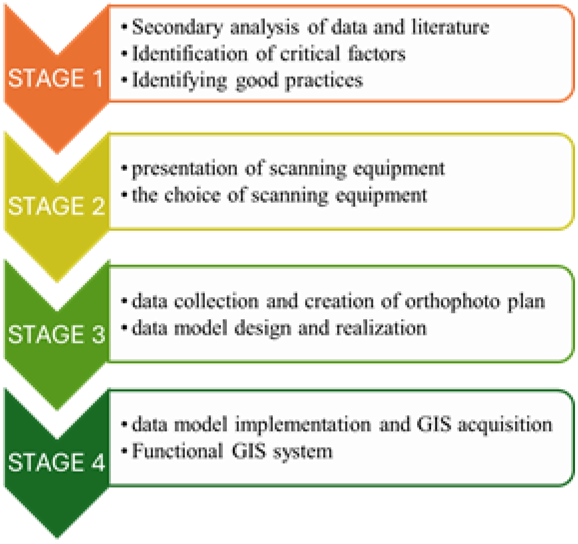

Figure 1. Schematic structure of the research

The schematic structure of the research highlights its development in four stages. In stage 1, we proceeded to collect data and information for the research using the questionnaire applied at the territorial administrative unit (UAT) level, the secondary analysis of statistical data, and the relevant specialized literature, respectively the observation for the qualitative improvement of the information. In the second stage, the scanning equipment was studied and it was opted for scanning using sensors carried with the help of the UAV. Specifically, the Drana Matrice 300 RTK capable of creating 2D, 3D, and detailed models was used. The third stage consisted of the collection of data and the creation of the orthophotoplan, respectively in the design and creation of a data model. The fourth stage is obtaining the GIS model.

RESEARCH RESULTS

The flight planning was done with the open-source software product Mission Planner.

The research consisted of identifying and mapping what makes the research objects. For this we used Google Maps and calculated the flight area. This enabled the export of a KML file with information for Mission Planner. This was followed by the entry of data related to the flight planning, the model of the cameras used and its focal length, the angular positioning of the camera, the altitude at which the flight will take place, the speed of the drone, the degree of transversal and longitudinal overlap, etc. This is how the flight path was established (figure 2 and figure 3)

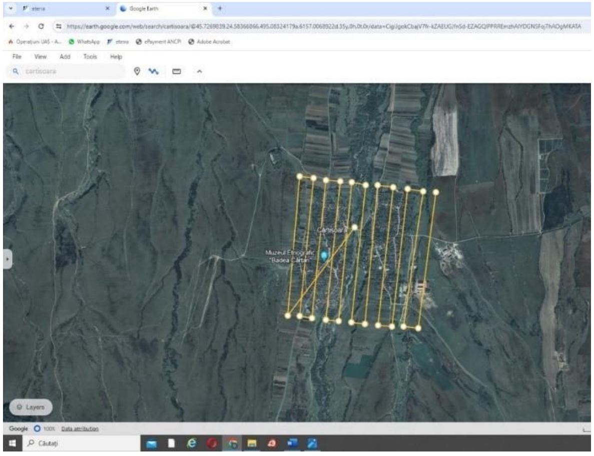

Figure 2. Flight planning details data acquisition

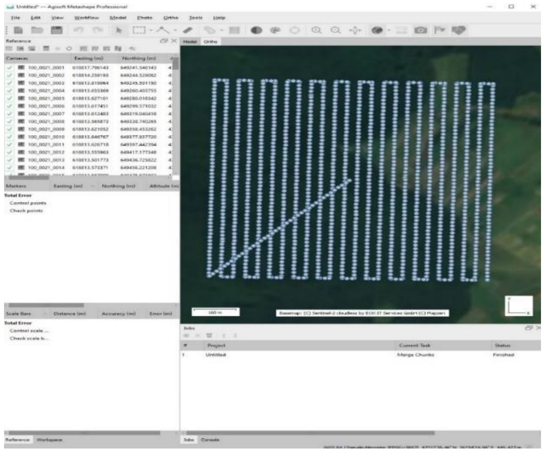

Figure 3. Route traveled by the drone equipment in flight

The collected data were processed to obtain an orthophotoplan. This was achieved by carrying out the following activities: Raw data processing (set of 518 frames), • Obtaining the main targeted result: orthophoto plane (digital 2D surface model), • Obtaining secondary products: Digital Elevation Model (DEM); The digital model of the, 3D surface; Dot cloud, • Map in KMZ format (Google Earth)

The following software was used for data processing: ZwCAD Professional, Agisoft PhotoScan, ArcGIS Suite (ArcMap, ArcCatalog)

Raw data processing within Agisoft PhotoScan involved: Adding a folder, Transforming without transcalculation parameters, and exporting the initial coordinates to a txt file. From each folder with pictures, columns G, H, and I are taken from the Timestamp. mrk file. They delete the suffixes and put all the columns in a single Excel, after which it is transcalculated on Translt online; Replacing the initial values with those processed using the online translated program; Importing the reference; select images with 0.02 precision; The 2D orthophoto plane is obtained from the workflow (figure 4).

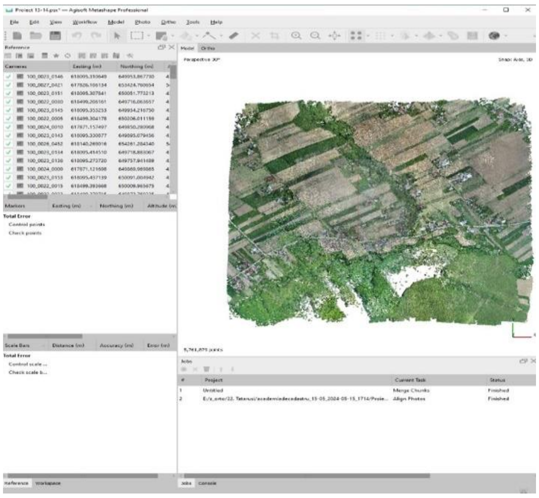

Figure 4. Orthofothomap

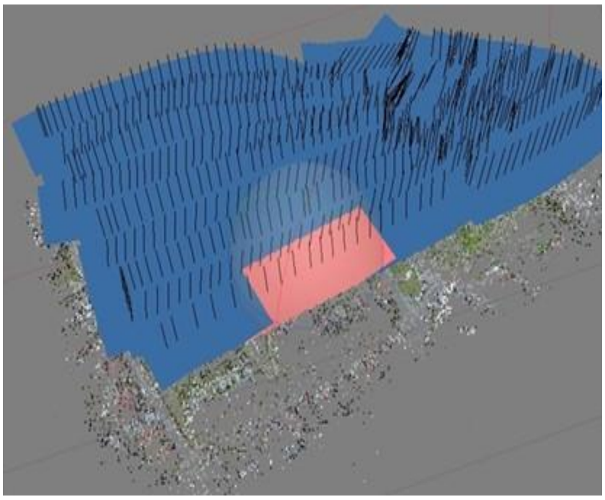

Figure 5. Cloud of dots

Next, we moved on to combining the frames and obtaining the cloud of points (figure 5).

Next, the 3D polygonal model was obtained using the previous data and different parameters such as: surface type, point cloud, number of faces, interpolation.

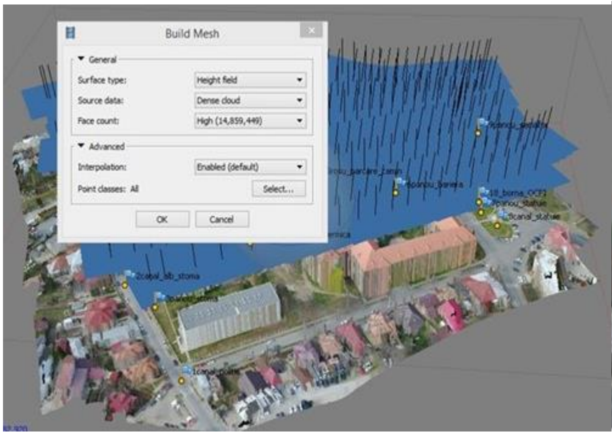

Figure 6. Generation of the 3D polygonal model

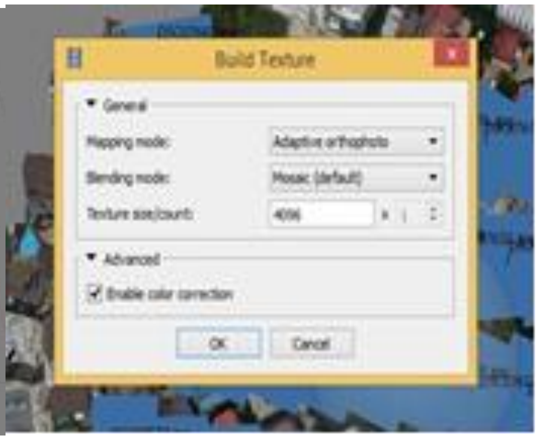

Figure 7. Data structure generation parameters

By correctly setting the mentioned parameters, it was possible to obtain a structure of the cause. Next, the digital elevation model (DEM) was created (figure 8).

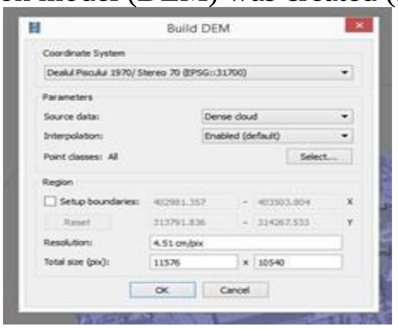

Figure 8. Digital Elevation Model (DEM) generation parameters

Starting from the achievements presented, I created the design the data model.

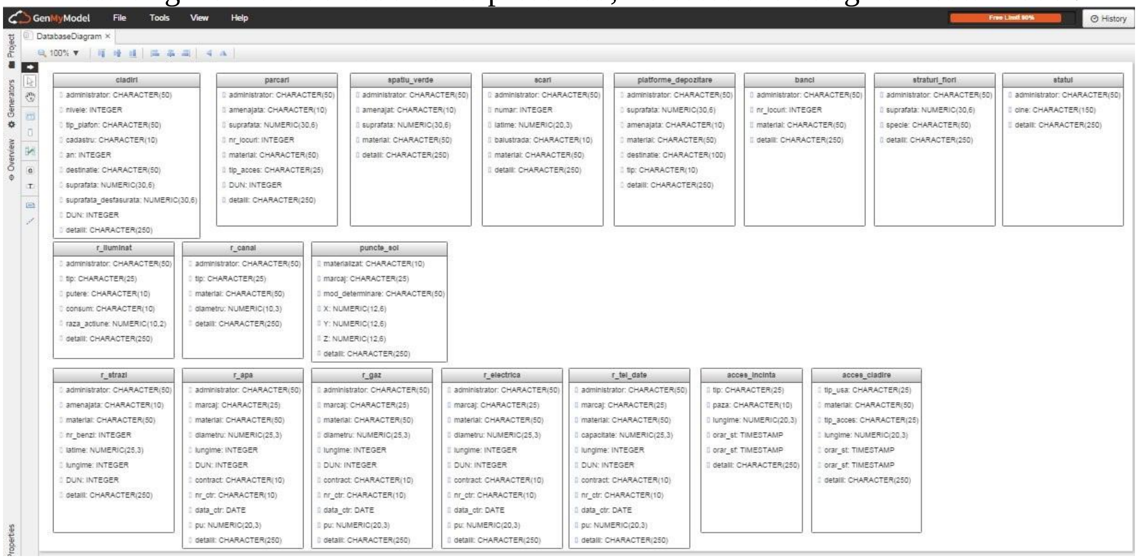

Figure 9. Database model (data structures)

Implementation of the data model (database) materialized in the following activities:

- Map georeferencing / orthophoto plan based on points marked on the ground
- Drawing / vectorizing elements of interest (polygon, line, point type)

• Entering related value sets ArcGIS for Desktop version 10.3.1 software was used for georeferencing the map / orthophoto plan based on the points marked on the ground of the case study. (brief overview at: http://www.esri.com/library/brochures/pdfs/arcgis-desktop.pdf).

Following the measurements, the following inventory of coordinates was obtained:

Table 1.

Inventory details of GPS measurement coordinates

Nr.crt.	X (m)	Y (m)	Z (m)	Details
1	467013.193	470317.381	494.870	rectangular canal at the entrance to the commune
2	466953.872	469902.502	494.900	Rectangular channel national road.
3	466731.680	469672.695	494.950	Rectangular channel near Grandma's House
4	466914.265	469494.041	495.101	rectangular channel national road
5	466768.974	469154.739	495.205	national road post at the exit from the commune
6	467338.487	469895.056	494.381	terminal near the school
7	467338.487	469895.056	494.381	terminal near the park
8	467525.948	470182.443	495.501	rectangular channel on the road to Arpasul de Jos
9	467744.810	470118.427	495.602	terminal in front of the Town Hall of Cartisoara commune
10	467515.699	469716.783	495.750	rectangular channel main road
11	467593.025	469534.312	495.859	Terminal at the exit from the commune
12	467661.940	469164.808	496.050	bolt on the alley towards the fireplace 3

Source: own data processing

Following the georeferencing, it can be seen that a coordinate system has been assigned to the map / orthophoto plane and that any point can be identified by coordinates in the Stereo 70 system (at the same time, a system of measurement units has been assigned - the metric system) (figure 10, a și b).

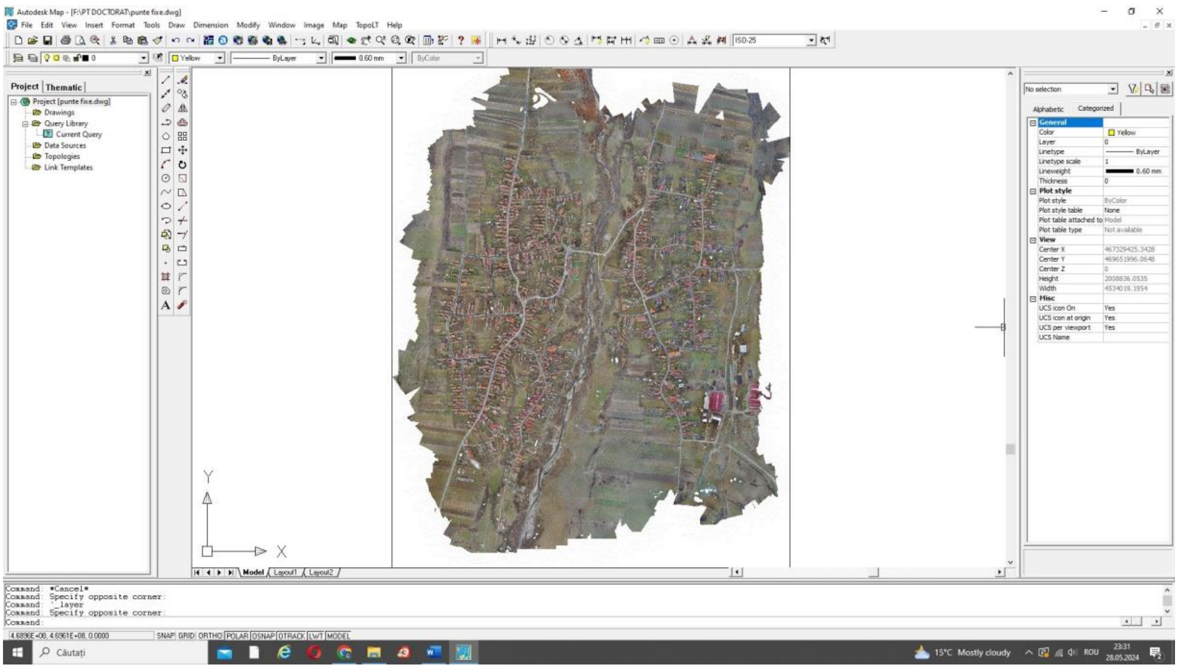

Figure 10.a. Georeferenced orthophotoplane

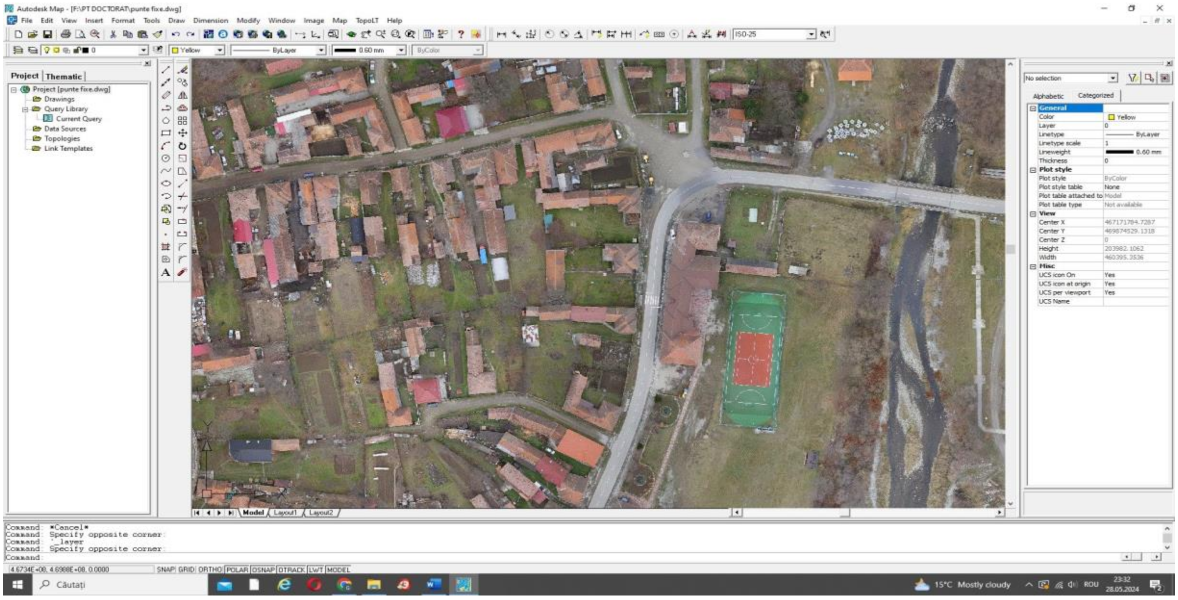

Figure 10.b. Georeferenced orthophotoplane

CONCLUSIONS

The commune of Cârțișoara has many resources that can act as a generating engine for local development, by outlining a vision of sustainable development, for which a GIS system provides faster and detailed necessary data that underpins the strategic planning process.

The research methodology adopted is the case study because it involves the in-depth study of the rural economy, in the natural framework of the commune of Cârtisoara, from several perspectives.

The development of unmanned aircraft systems is a certainty of the present in which society shows an increased interest, including in the collection of data for the realization of a geographic information system.

The stages of raw data acquisition through aerial photography and their graphic processing require numerous resources (financial, time, technical);

The study undertaken is oriented towards the use of methods, means, and modern analysis tools carried out within the case study methodology.

The study represents a contribution to the management of the activities of strategic orientation of sustainable development in Cârțișoara UAT, through the use of modern aerial scanning techniques, the creation of a GIS database and the integration of information for the development of relevant strategic options

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