



UNIVERSITY OF LIFE SCIENCES "KING MIHAI I" FROM TIMISOARA

"YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH IN APPLIED LIFE SCIENCES"



"Young people and multidisciplinary research in applied life sciences"

21-22 November 2024

MODERN TECHNOLOGIES IN CADASTRE: A REVIEW OF UAV AND GIS APPLICATIONS

ALIN CORNELIU MINEA¹, SAMUEL KIAJI¹, MAROUA DAHBI¹, ADRIAN SMULEAC¹, Raul PAȘCALĂU¹,
¹University of Life Sciences" King Mihai I" from Timisoara, 300645, 119, Calea Aradului, Timisoara, Romania
e-mail: adrian.smuleac@usvt.ro

Abstract: The use of new technologies in cadastre work has changed old land management systems, making data gathering and handling more correct and efficient. Among these technologies, Unmanned Aerial Vehicles (UAV) and Geographic Information Systems (GIS) are important for solving tough problems with land surveying and mapping. UAVs give high-quality aerial pictures and can quickly collect data over large spaces, while GIS has strong tools for viewing and understanding spatial data. This mix not only makes cadastre tasks more precise but also helps in making better decisions in city planning, environmental checks, and managing resources. In addition, the cooperation of UAV and GIS technology opens doors to new uses in different areas, as shown by their vital part in good land management plans. To show these ideas, the diagram included demonstrates how GIS applications can cover different management areas, underlining the importance of modern technologies in current cadastre work.

• Introduction

The use of new technologies in cadastre has changed old land management methods, making data collection and handling more efficient and accurate. With improvements in Geographic Information Systems (GIS) and Unmanned Aerial Vehicles (UAVs), professionals can now gather high-quality spatial data, which makes land registration better. Before, traditional methods relied a lot on ground surveys; however, the quick growth of remote sensing technologies, like those mentioned in studies cited by (Asiama et al.), has shown that aerial and satellite images can work well alongside standard methods. In addition, the rise of digital tools allows for constant updates and immediate analysis of land data, meeting the growing need for complete and interchangeable land information systems, as pointed out in ('MDPI AG'). Thus, the ongoing connection between these new technologies not only demonstrates their practical use in cadastre but also highlights their validity in tackling current land management issues, leading to new solutions in this area

• Material and method

This review aims to look closely at the progress made in combining Unmanned Aerial Vehicles (UAV) and Geographic Information Systems (GIS) in cadastre work. By examining the background and development of these technologies, this study tries to set up a clear framework that shows how they help improve efficiency and accuracy in land management. Previous studies note that the use of photogrammetry and remote sensing has been crucial since they started but is often not fully valued ((Asiama et al.)). Additionally, this review will outline the current research landscape, responding to the push for Land Administration 2.0, which calls for new methods to be used in cadastre processes (('MDPI AG')). In summary, this review seeks to compile existing literature, find research gaps, and encourage discussion on the need for updated technological systems, which will ultimately enhance land management practices. To visually support this discussion, [extractedKnowledge1] effectively shows the various uses of GIS in land management, highlighting the importance of these technologies in cadastre improvements.

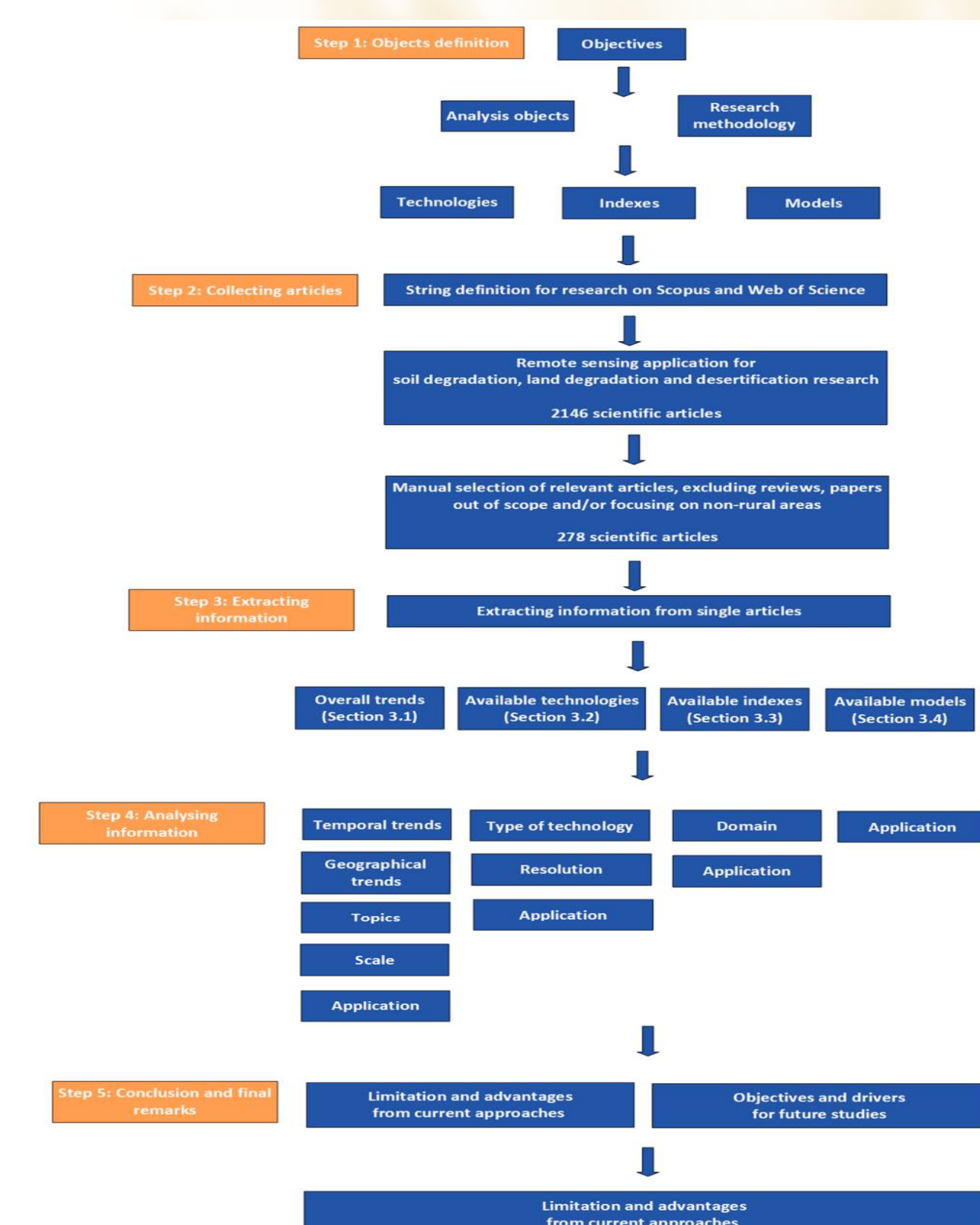


Image2. Flowchart of the research methodology for studying soil degradation using remote sensing.

Cost-Effectiveness of UAV vs. Traditional Surveying Methods

In the changing area of land surveying, the cost-effectiveness of Unmanned Aerial Vehicles (UAVs) compared to traditional techniques is an important factor. UAVs lower operational costs by reducing the number of workers and time needed for large surveys, reinforcing the growing use of remote sensing technologies in land management (Asiama et al.).



Comparative Analysis of UAV and GIS Applications

Application	Accuracy (%)	Cost (\$ per sq km)	Time Saved (hours)	Area Covered (sq km per day)	Data Acquisition Frequency (days)
UAV	85-95	500-1500	5-15	100-200	1-7
GIS	75-90	100-1000	3-10	10-50	30-60

• Results and discussions

UAV Technology in Cadastre

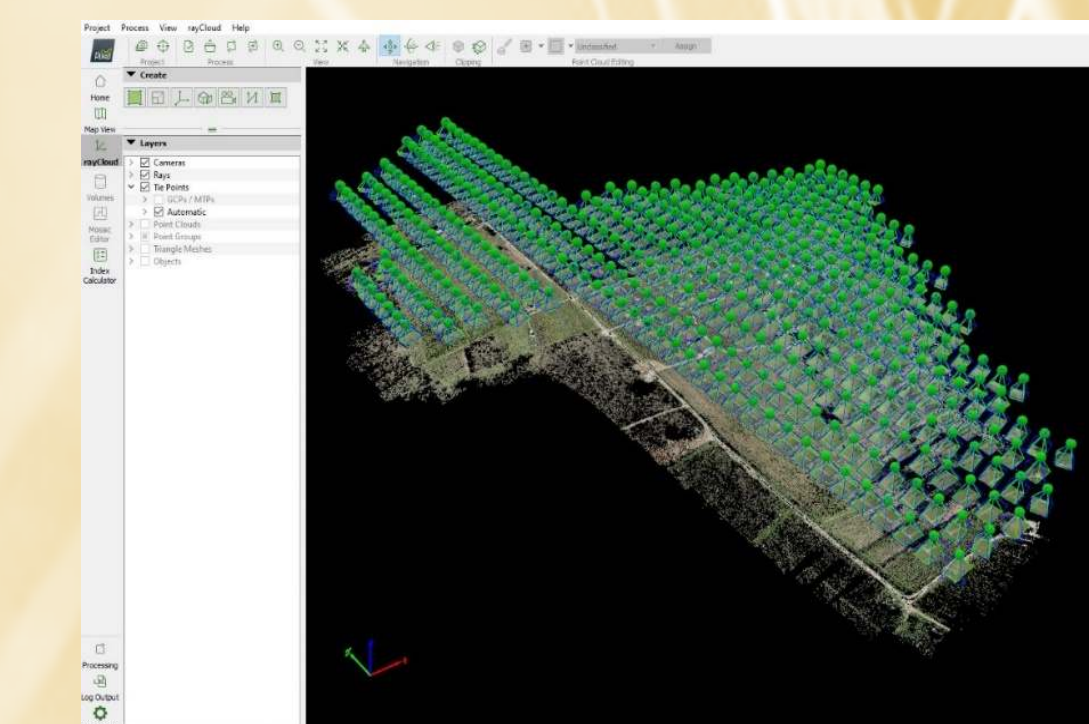
The use of Unmanned Aerial Vehicle (UAV) technology in cadastre systems brings clear improvements in efficiency and data precision. Drones, with their advanced sensors, enable land surveyors to quickly gather high-quality images, which helps in making detailed orthophoto maps and digital terrain models. This aerial view provides a better understanding of spatial relationships and land features that ground surveys might overlook. Additionally, UAVs greatly lower the time and expense needed for large surveying projects, making them a sensible choice for land administration tasks.



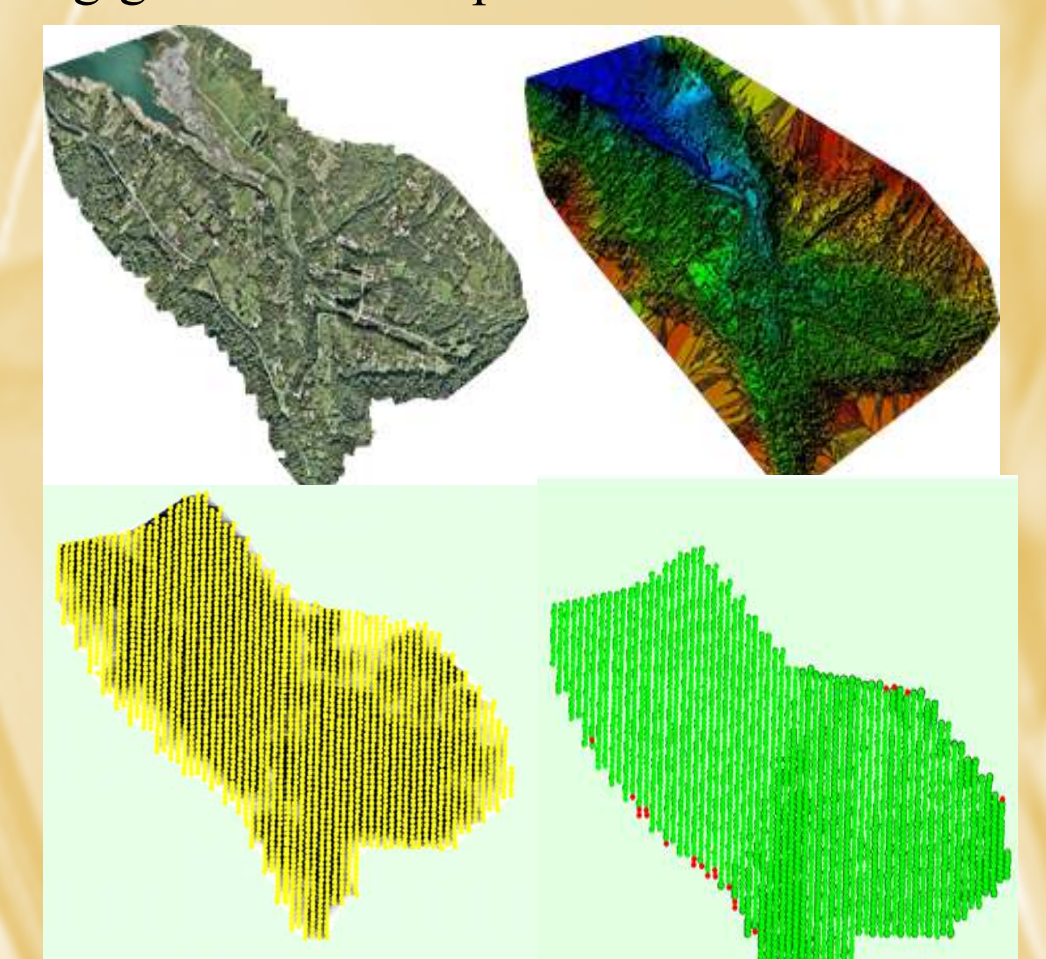
A. Principles of UAV Operation and Data Collection

In land administration, Unmanned Aerial Vehicles (UAVs) have become an important tool for collecting data, thanks to their ability to gather high-quality images and spatial information quickly. The basics of how UAVs work include knowing about flight mechanics, combining sensors, and processing data. To run successful UAV missions, careful planning is crucial, which involves choosing the right altitudes, ensuring overlap, and placing ground control points to achieve accurate positioning.

Use of the WintraOne UAV system in general cadaster



The Pix4D program



Integration of UAV Data with GIS for Enhanced Mapping

A. The combination of Unmanned Aerial Vehicles (UAV) and Geographic Information Systems (GIS) is important in improving mapping methods, especially in cadastre. By using UAVs for clear aerial photos, urban planners and land officials can gather detailed geographical information that greatly improves GIS tools.

Challenges and Limitations of GIS in Cadastre

Although Geographic Information Systems (GIS) have great potential for cadastre applications, various challenges and limitations prevent their effective use. Primarily, data accuracy is a big issue, as merging different data sources can cause inconsistencies, making it hard to define property boundaries and ownership records.

Comparative Analysis of UAV and GIS Applications

New technologies, especially UAVs and GIS, have changed how cadastre processes are carried out, with each providing unique yet helpful benefits. UAVs can perform high-resolution aerial surveys, allowing quick data collection over large spaces, which is useful in places hard to reach or unsafe for normal surveying. On the other hand, GIS offers strong spatial analysis tools that help combine and interpret spatial data, which is vital for making decisions in land management.

Cost-Effectiveness of UAV vs. Traditional Surveying Methods

method	cost per hectare usd	time saved hours	accuracy percent
UAV	100-250	20-30	90-95
Traditional Surveying	300-500	0-5	85-90

Accuracy and Precision in Data Collection Using UAV and GIS

Technology	Accuracy (cm)	Precision (cm)	Source
UAV	2.5	1	NASA, 2022
GIS	5	2.5	ESRI, 2023
UAV + Ground Survey	1.2	0.5	Johns Hopkins University, 2023
Traditional Surveying	10	5	International Federation of Surveyors, 2023
Remote Sensing	3	1.5	European Space Agency, 2023

• Conclusions

The use of new technologies in cadastre, especially UAV and GIS tools, shows how they change traditional surveying methods. Recent progress shows that these technologies allow for data collection that is faster, more precise, and cheaper, which helps in making better decisions in land administration. Using these new tools not only makes it easier to handle cadastral data but also meets the growing need for quick, accurate data, as mentioned in the discussion on Land Administration 2.0 ('MDPI AG'). Additionally, the ability to get three-dimensional data from UAV images improves how we understand and manage spatial information, as shown in the creation of workflows for Cadastral Geospatial Information (Williams et al.).