



# UNIVERSITY OF LIFE SCIENCES "KING MIHAI I" FROM TIMISOARA

YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH  
IN APPLIED LIFE SCIENCES

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"Young people and multidisciplinary research in applied life sciences"

## ASSESSING THE IMPACT OF IRRIGATION PRACTICES ON SOIL MOISTURE AND CROP HEALTH USING REMOTE SENSING AND HYDROLOGICAL MODELLING

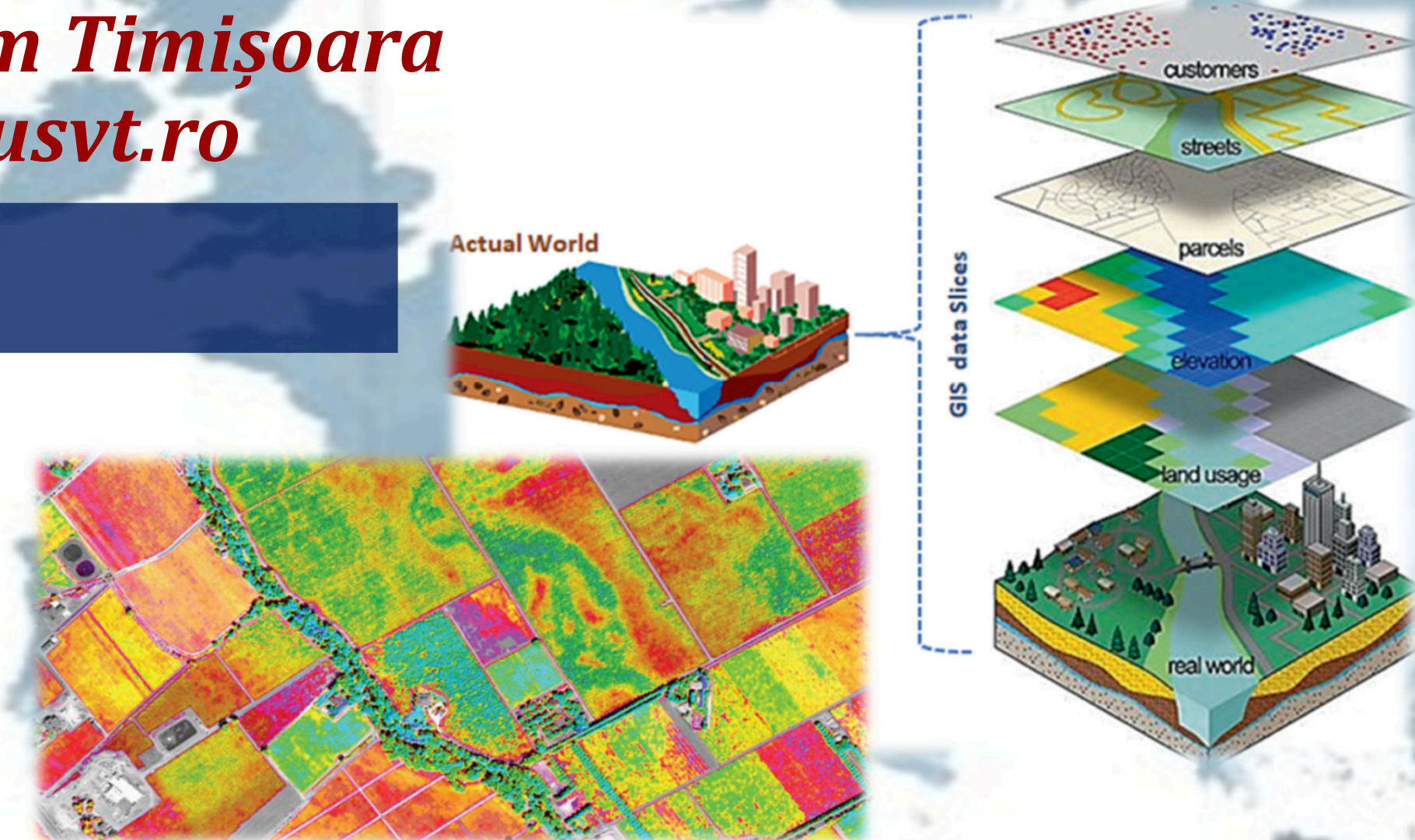
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### Introduction

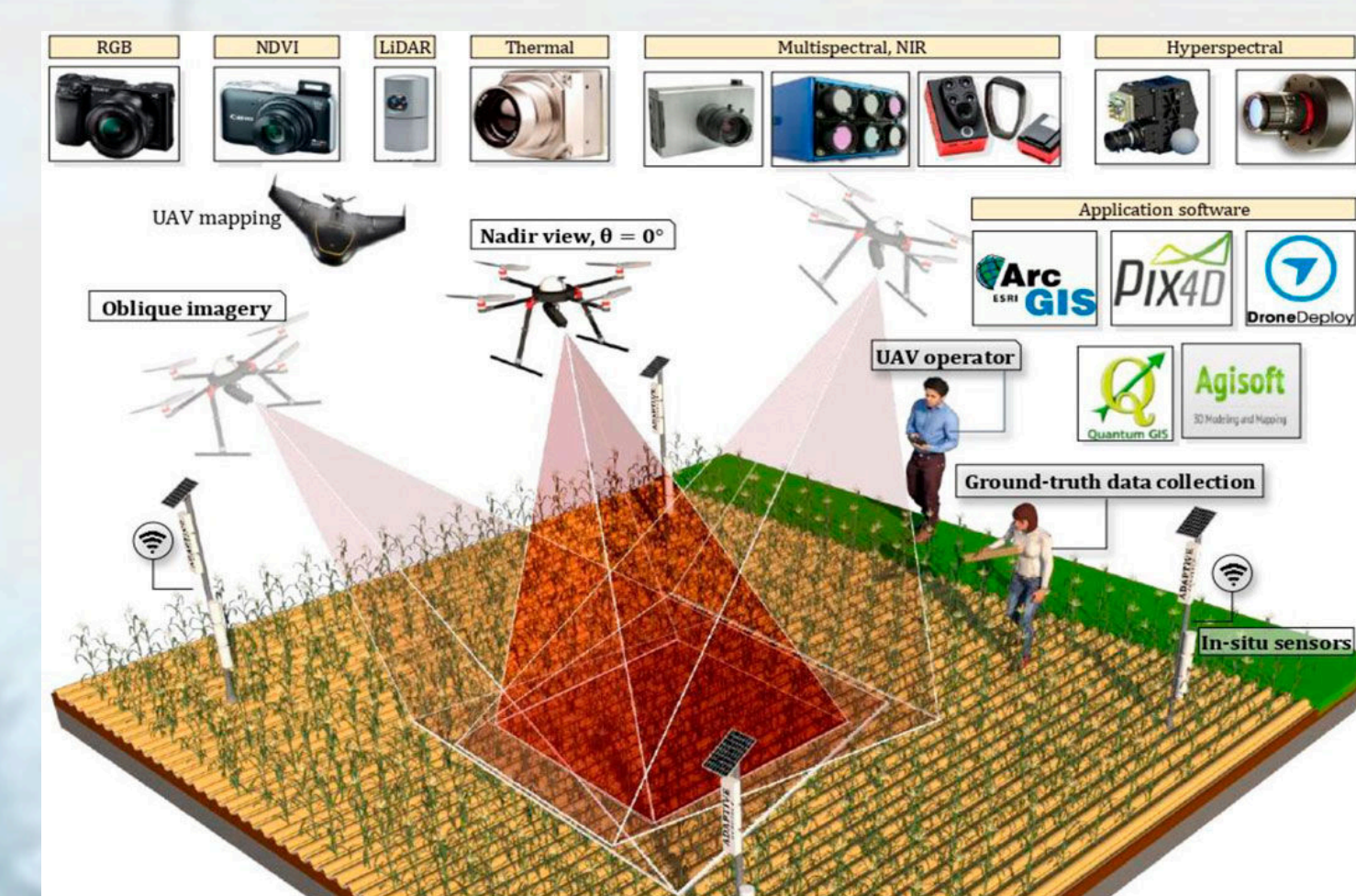
Water is one of the most critical inputs in agricultural production, yet it is also a limited and increasingly stressed resource. Inefficient irrigation practices often result in excessive water use, soil salinization, nutrient loss, and reduced crop productivity. With climate change intensifying rainfall variability and drought frequency, the need for sustainable water management in agriculture has become more urgent than ever. Recent advances in remote sensing (RS) and hydrological modelling provide effective tools for monitoring irrigation efficiency, soil moisture dynamics, and plant response across large spatial scales.



### Material and method

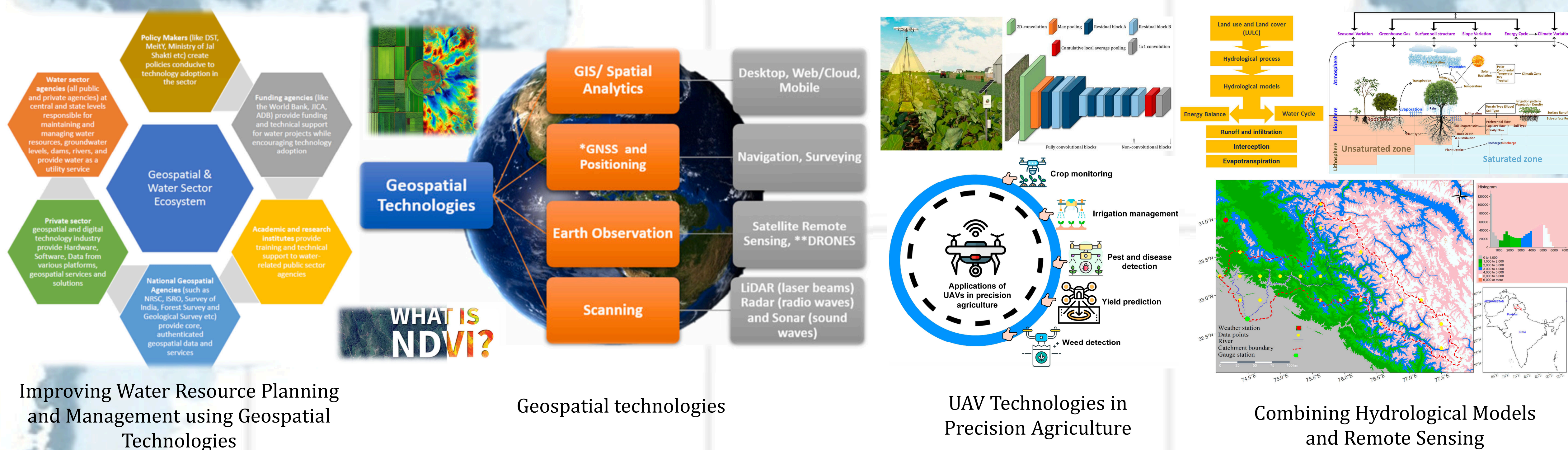
The study combined satellite-based remote sensing analysis with GIS-integrated hydrological modelling to assess irrigation performance. Multi-temporal Sentinel-2 and Landsat 8 images were processed to compute NDVI and NDWI indices for monitoring vegetation vigor and surface water content. Image pre-processing included radiometric correction, atmospheric adjustment, and geometric rectification to ensure data consistency.

Field observations were conducted to measure soil moisture, crop biomass, and yield parameters, which were used to calibrate and validate satellite-derived indices. Meteorological data (precipitation, temperature, solar radiation) were incorporated into a hydrological model developed in ArcGIS using tools such as SWAT (Soil and Water Assessment Tool) and HEC-HMS for runoff and infiltration analysis.



### Result and discussions

The integration of UAV and GIS technologies yielded highly detailed and accurate geospatial products suitable for the results revealed clear differences in soil moisture distribution and crop response among irrigation systems. Drip irrigation produced the most uniform moisture levels across fields, maintaining optimal NDVI values throughout the growing season. Sprinkler irrigation showed moderate variability, while flood irrigation led to uneven moisture conditions, localized saturation, and periods of water stress in elevated zones. Hydrological simulations confirmed that drip systems achieved the highest water use efficiency (WUE) and the lowest surface runoff, whereas flood irrigation generated higher losses through evaporation and deep percolation. NDWI analysis supported these findings, indicating higher moisture stability under precision irrigation methods. Spatial overlays in GIS showed strong positive correlations ( $R^2 > 0.8$ ) between NDVI and modeled soil moisture, validating the reliability of remote sensing for assessing crop-water interactions. The integration of hydrological modelling and satellite data provided valuable insights into the timing and quantity of irrigation required to optimize crop health and reduce water waste. These findings emphasize the importance of adopting precision irrigation technologies and data-driven management to enhance sustainability in water-limited agricultural systems.



### Conclusions

The integration of remote sensing and hydrological modelling proved highly effective for evaluating irrigation practices and their effects on soil moisture and crop health. Drip irrigation systems were shown to deliver superior water efficiency, soil moisture stability, and crop vigor compared to conventional flood irrigation methods. By combining NDVI and NDWI analysis with hydrological simulations, this research demonstrates a practical framework for real-time monitoring and optimization of irrigation management. Future research should expand on long-term data collection, integrate UAV-based monitoring, and explore AI-driven irrigation control systems to further enhance precision in water management.

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