FORUM GEOGRAFI
ISSN: 0852-0682 | E-ISSN: 2460-3945

HTTPS://JOURNALS.UMS.AC.ID/INDEX.PHP/FG/

Research article

Tourism Investment and Land Use Change in the Northern Piedmont of the Western High Atlas (1989-2022)

Hamza Ait Zamzami[1,*], Mohammed Elaanzouli[1], Ayoub Zahrani[1], Jamila Saidi[1], Taieb Boumeaza[1], Muhammad Musiyam[2]

[1] Laboratory of Dynamics of Spaces and Societies (LADES), Department of Geography, Faculty of Arts and Humanities, HASSAN II University of Casablanca, Mohammedia, Casablanca 20000, Marocco
[2] Faculty of Geography, Universitas Muhammadiyah Surakarta, Surakarta 57169, Indonesia

[*)]Correspondence: hamza.aitzamzami-etu@etu.univh2c.ma

Citation:

Ait Zamzami, H., Elaanzouli M., Zahrani A., Saidi J., Boumeaza T., & Musiyam M. (2024). Tourism Investment and Land Use Change in the Northern Piedmont of the Western High Atlas (1989-2022). Forum Geografi. 38(1), 83-93.

Article history:
Received: 29 February 2024
Revised: 7 March 2024
Accepted: 8 March 2024
Published: 1 April 2024

Abstract

This study aimed to investigate the profound influence of tourism investment on the northern piedmont of the western High Atlas over 34 years in response to the escalating global trend of tourism-driven land-use changes, particularly in the Marrakesh region. In this context, the driving forces behind the significant transformation of agricultural land and bare soils into tourism-driven investments were evaluated, and the critical role of accessibility was examined in shaping spatial shifts. The method used high-resolution (10 m) satellite images from Spot 1 (1989), Spot 5 (2003 & 2010), and Sentinel 2 (2022) through remote sensing methods to investigate the historical land-use changes over 34 years. The results showed significant transformations in land use based on the correlation between improved transportation infrastructure and the growth of tourism ventures, underscoring the role of roads and facilities as catalysts. The analysis suggested the need for reflection on the consequences of unregulated tourism growth, aiming to balance economic benefits with environmental and socio-cultural challenges in sensitive regions. Although tourism significantly contributed to economic development and employment opportunities, it also posed risks when not managed prudently. This underscored the need to strike a harmonious equilibrium between economic prosperity and the preservation of the region's unique natural beauty and cultural heritage. The insights provided in this analysis had broader implications for responsible planning and management of tourism development in sensitive ecological and cultural regions. In conclusion, a thoughtful and sustainable approach was needed to safeguard the delicate balance between economic prosperity and environmental preservation.

Keywords: tourism investment; land-use dynamics; spatial remote sensing; accessibility and tourism; sustainable tourism development.

1. Introduction

Tourism is an important economic activity capable of stimulating economic growth, creating jobs, and fostering sustainable development (Raihan, 2024; Susila *et al.*, 2024). Investment in this sector plays a crucial role in improving the quality of life among local populations, serving as a driver of regional and national development (Makkonen & Williams, 2024; Tong & Zhang, 2022). However, negative environmental and social impacts may occur in the absence of appropriate planning and management (Glyptou, 2022; Khusnani *et al.*, 2023; Prayag *et al.*, 2023). Tourism investment has a significant impact on land-use changes (Yasemin Sarıkaya Levent *et al.*, 2024), leading to the conversion of agricultural and forest land into golf courses, leisure parks, or shopping malls, with negative consequences for local livelihoods and biodiversity (Mattah *et al.*, 2024). The construction of tourism infrastructure potentially leads to habitat fragmentation and a loss of ecological connectivity, which may affect the survival of certain animal and plant species (Ma *et al.*, 2024). However, tourism investment can also help to protect the environment and conserve natural landscapes, particularly in areas threatened by unregulated development or unsustainable economic activities. In response, natural areas are preserved, and more income is generated for local communities through activities such as birdwatching, wildlife tourism, and ecotourism (Higgins-Desbiolles *et al.*, 2018; Pengfei Zhang *et al.*, 2024).

Marrakech region is one of Morocco's most popular tourist destinations, and it is known for its rich cultural heritage, bustling markets, and spectacular scenery. However, the rapid growth of tourism in recent years has also created social and environmental challenges that must be addressed to ensure the sustainability of the industry (Rafik, 2023). Existing scholarly literature pertaining to sustainable tourism in the Marrakech region of Morocco has extensively examined multiple facets of the business, encompassing regulatory interventions, social and environmental obstacles, and the imperative for adopting sustainable practices. Previous study conducted by Mohamed *et al.* (2019) and Gomih *et al.* (2021) have mainly examined sustainable tourism policy in the region. However, a significant research vacuum pertains to the spatial dimension of land use change and its influence on tourism investment.

In response to the gap, this study focuses on the northern piedmont of the Western High Atlas, an area witnessing a surge in tourism investment. This trend, driven by the region's popularity and government initiatives, significantly impacts land use and natural resources. To address the lack of data, spatial remote sensing methods and high-resolution satellite imagery (10 meters) from SPOT 1, SPOT 5, and Sentinel-2 satellites were used to analyse land-use changes over 34 years (1989-2022) in the western High Atlas Piedmont. By providing a "solid ground truth" on past developments, the results offer insights for stakeholders into the impact of legitimate tourism investment and the grouping patterns of illicit activities. The insights can help understand the crucial role of infrastructure, particularly network roads, in facilitating tourism investment, the dynamic relationship between these activities, and potential contribution to local enrichment. This entails contemplating investment in sustainable tourism, which aims to balance economic development with considerations for environmental and social well-being (Susila *et al.*, 2024).

To achieve the objective, this article is organised as follows: the next section will elaborate on the data analyses from satellites SPOT 1, SPOT 5, and Sentinel-2 to identify land use changes and environmental implications—results and discussion follow this section. Finally, it ends up with a conclusion section.

2. Research Methods

2.1 Study Area

The study area, located in the heart of the piedmont of the western High Atlas (Dir of Marrakech), extends over 1500 km², from Marrakech City in the north to the Atlas Mountains in the south, covering 12 territorial communes (Figure 1). These include Moulay Brahim, Ourika, Tameslohte, Aghouatim, Sidi Abdellah Ghiat, Ghmat, Tassoultante, Lalla Takarkoust, Ouazguita, Ait Faska, Tamazouzte, and Tahannaout. This area is characterised by lush green valleys, luxuriant palm groves, spectacular farmland, and low topography, creating a unique and attractive ecosystem for a livable space. The Atlas Mountains, which dominate landscape, play a crucial role in regulating the local climate and the distribution of rainfall. The region is also home to essential natural resources, such as fertile, agriculturally-suitable soils and groundwater sources (Abdelfadel *et al.*, 2021; Roubil, *et al.*, 2022).

Due to the unique attractions, the study area is a must-see tourist destination (Ali *et al.*, 2021), with the picturesque landscapes attracting nature lovers and adventurers. The rich Berber culture is also on display, with authentic traditions and immersive cultural experiences.

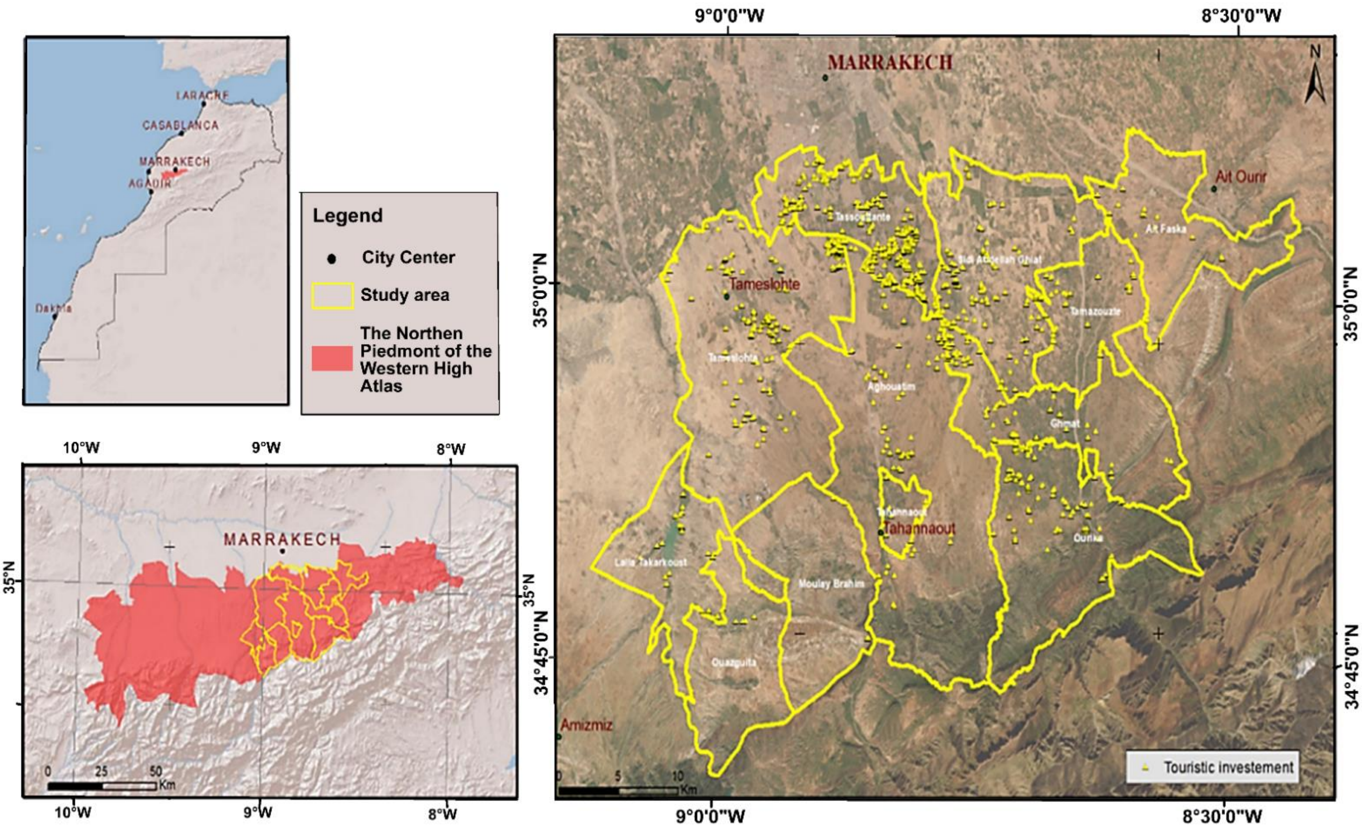

Figure 1. Geographic location of the study area.

2.2 Data

The data used for this study were collected from a variety of sources (Table 1). For 1989, SPOT-1 images were used with 20 m and 10 m resolution (visible and panchromatic), while for 2003 and 2010, SPOT-5 images were used with 10 m resolution (Nosavan *et al.*, 2020). Finally, for 2022, Sentinel 2-A images were used with 10 m resolution, supplied by the ESA (European Space Agency) platform on Table 1.

Table 1. Characteristics of satellite data used.

Satellite	Launch	Selected date	Spatial resolution	Spectral bands
SPOT-1	1986	September 1989	Panchromatic band 10 m. Multispectral bands 20 m.	Green band (0.50 - 0.59 µm) Red band (0.61 - 0.68 µm) Near-infrared band (0.79 - 0.89 µm)
SPOT-5	2002	July 2003 and August 2010	Panchromatic band 2,5 m. Multispectral bands 10 m.	Green band: 0.50 - 0.59 µmy- Red band: 0.61 - 0.68 µm Near-infrared band: 0.79 - 0.89 µm
Sentinel 2	2015	July 2022	Bands 2, 3, 4, 8, 11, and 12: 10 meters, Bands 5, 6, 7, 8A, and 9: 20 meters, Bands 1 and 10: 60 meters.	Band 1 (Blue): 0.435 - 0.450 µm Band 2 (Green): 0.490 - 0.510 µm Band 3 (Red): 0.620 - 0.670 µm Band 4 (Bright Red): 0.665 - 0.680 µm Band 5 (Near-infrared): 0.690 - 0.710 µm Band 6 (Near-infrared): 0.740 - 0.760 µm Band 7 (Near-infrared): 0.770 - 0.790 µm Band 8 (Near-infrared): 0.835 - 0.865 µm Band 8A (Near-infrared): 0.860 - 0.880 µm Band 9 (Short-wave infrared): 0.935 - 0.955 µm Band 10 (Short-wave infrared): 1.360 - 1.390 µm Band 11 (Short-wave infrared): 1.560 - 1.660 µm Band 12 (Short-wave infrared): 2,100 - 2,300 µm

Aside from satellite data, aerial imagery was used to obtain historical terrain samples. These samples were extracted using Google Earth Pro. Vector data were also used to delimit the study area and locate tourism investment, while satellite image processing and spatial analysis were carried out using QGIS and SNAP. The software packages were used for in-depth analyses of the images, extracting relevant information, and performing spatial manipulations to meet the objectives of the study.

2.3 Preprocessing

Several preprocessing processes were applied for the satellite and aerial data used to improve image quality and facilitate analysis.

- Atmospheric correction: Satellite images can be affected by atmospheric effects such as light scattering and absorption. Atmospheric correction reduces these effects and makes images more faithful to the earth's surface (Bégué *et al.*, 2020; Sòria-Perpinyà *et al.*, 2022).
- Georeferencing: Georeferencing entails associating images with precise geographic coordinates for consistency with a common spatial reference (Román *et al.*, 2024). This enables images to be superimposed on other geospatial data and analysed together.
- Geometric rectification: Geometric rectification eliminates distortions caused by topographical variations, image projection, and sensor movements. This ensures that images are accurately and consistently matched.
- Image fusion: Fusion entails combining several images of the same scene, such as multispectral and panchromatic, taken at different spectral bands or resolutions, to obtain a single composite image with richer information. In the specific case of the SPOT-1 multispectral image from 1989, image fusion was used to improve spatial resolution to 10 meters. This was achieved by combining with a suitable panchromatic image. Data analysis and visualisation become more precise and detailed by increasing spatial resolution, enabling better interpretation of the information contained in the composite image (Xing *et al.*, 2022).
- This preprocessing was carried out using specialised software such as QGIS, SNAP, or other image processing tools.

2.4 Data processing

2.4.1. NDVI

Once the satellite images had been preprocessed, including atmospheric correction, geo-referencing and geometric rectification, normalised difference vegetation index (NDVI) map was generated. The mathematical definition shows that NDVI of an area containing dense vegetation cover will tend towards positive values (0.3 to 0.8), while negative values characterise clouds and snow-fields.

Other terrestrial targets visible from space include stagnant water (oceans, seas, lakes, and rivers), which has a rather low reflectance in both spectral bands (at least far from the shore), resulting in very low or even slightly negative NDVI values (Landsat Normalized Difference Vegetation, 2023).

The images covering Marrakech Piedmont area with a spatial resolution of 10 m were imported into SNAP image processing software to calculate NDVI. NDVI was calculated using the Equation 1 (Chen, 2008; Sharma *et al.*, 2022). Where PIR represents the near-infrared band (0.835 - 0.865 µm) and R represents the red band (0.620 - 0.670 µm) (Sharma *et al.*, 2022).

$$NDVI = \frac{(PIR - R)}{(PIR + R)} \tag{1}$$

NDVI images were used to map land cover, due to the availability of high-resolution data for the years 1989, 2003, and 2010 (PIR, R bands). NDVI map obtained was used for land cover/land-use analyses, including classification, detection of changes in vegetation cover, and assessment of ecosystem health in the study area (Saha *et al.*, 2024).

2.4.2. Land use

Land cover was mapped after obtaining NDVI images of the study area for 1989, 2003, 2010, and 2022. NDVI method offers several advantages for land cover mapping, including being more sensitive to vegetation (Patil *et al.*, 2024; Li *et al.*, 2024). Using this index, it becomes possible to differentiate areas with dense vegetation from those with sparse levels (Alexandre *et al.*, 2024). This is because NDVI is derived by calculating the difference between the near-infrared (NIR) and red bands of a satellite image, as vegetation reflects NIR light more than red light. Furthermore, NDVI is relatively independent of atmospheric conditions (Peluzio & C, 2024), providing consistent estimates of vegetation even in the presence of clouds or other atmospheric phenomena (Lee et *al.*, 2024; Musiyam *et al*., 2020; Hadibasyir *et al.*, 2020). The method is not affected by atmospheric aerosols or water vapour, which can obscure the red and NIR bands of a satellite image. Finally, the ability to acquire NDVI images at different dates enables precise temporal monitoring of seasonal changses in vegetation and analysis of long-term trends. This ability is a major asset for land cover mapping. For example, NDVI can be used to track deforestation, monitor crop yields, and assess the impact of climate change on vegetation cover.

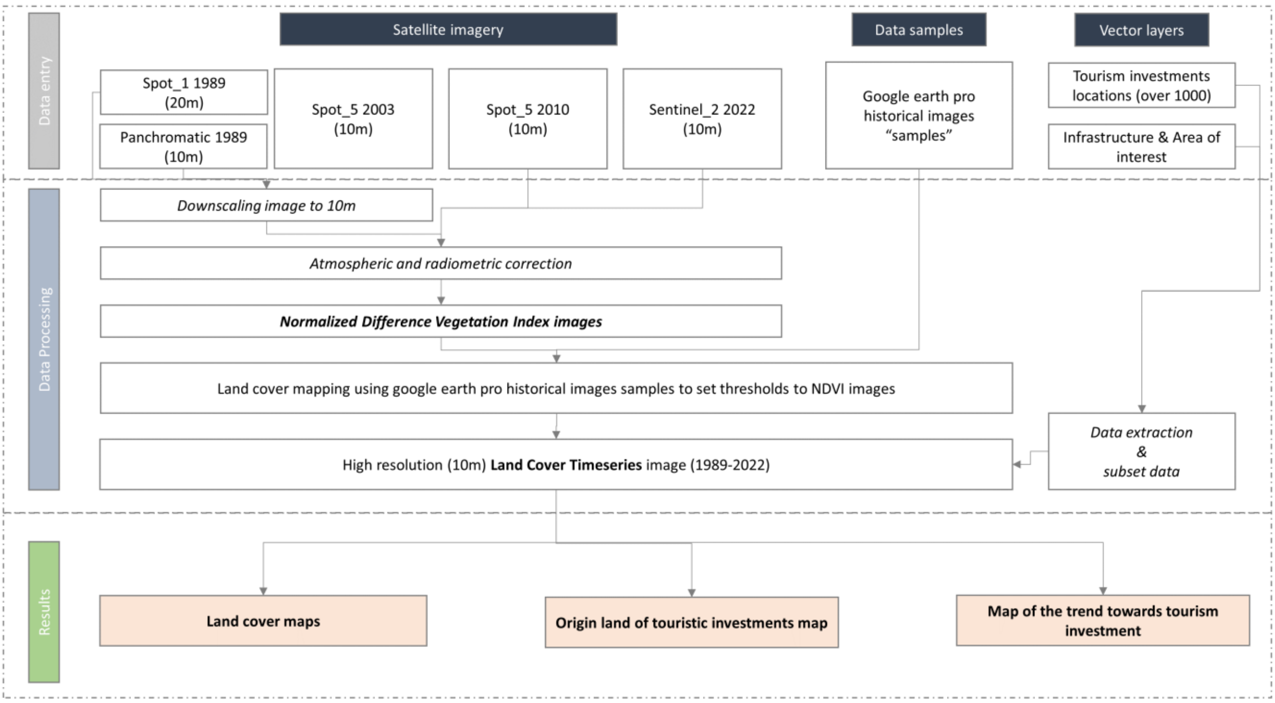

Figure 2. Method assessing the impact of tourism investment on land-use through satellite data.

Training samples were collected, and NDVI thresholds were determined to differentiate between different land-use classes. The five main classes identified include bare soil, pasture, and fallow land or Bour (non-irrigated crops), irrigated vegetation, trees and forests, and water bodies. These classes facilitated the analysis of trends and variations in the distribution of land-use types over time (Foody *et al.*, 2002). Understanding land use dynamics is crucial to identify ecological processes and environmental changes occurring in the study area (Herold *et al.*, 2008; Turner *et al.*, 2007).

3. Results and Discussion

The examination of 1037 samples shed light on the impact of tourism investment on land-use change and vocation. The land-use mapping results for the years 1989, 2003, 2010, and 2022, depicted in Figure 3, provided a foundational understanding of the temporal shifts in land utilization. Figure 4 further delved into the historical preoccupations with land use, highlighting the significant transformations experienced. Specifically, agricultural lands, comprising 407 samples of irrigated and tree crops, historically dedicated to farming activities, have undergone a transformation into tourist resorts. Similarly, areas categorized under weeds/grazing, which included 67 samples and were once used as natural pastures or for rain-fed cultivation, have become fallow following the advent of tourism projects. This transition suggests that the introduction of tourism infrastructure precipitated the abandonment of agricultural practices in these areas, making way for tourism-related developments. In contrast, bare soil, which accounted for 558 samples, did not witness substantial change in land use. However, these lands have been earmarked for tourism investments, notably for the construction of villas complemented by vegetated areas such as gardens and green spaces, indicating a nuanced approach to integrating tourism within the natural landscape.

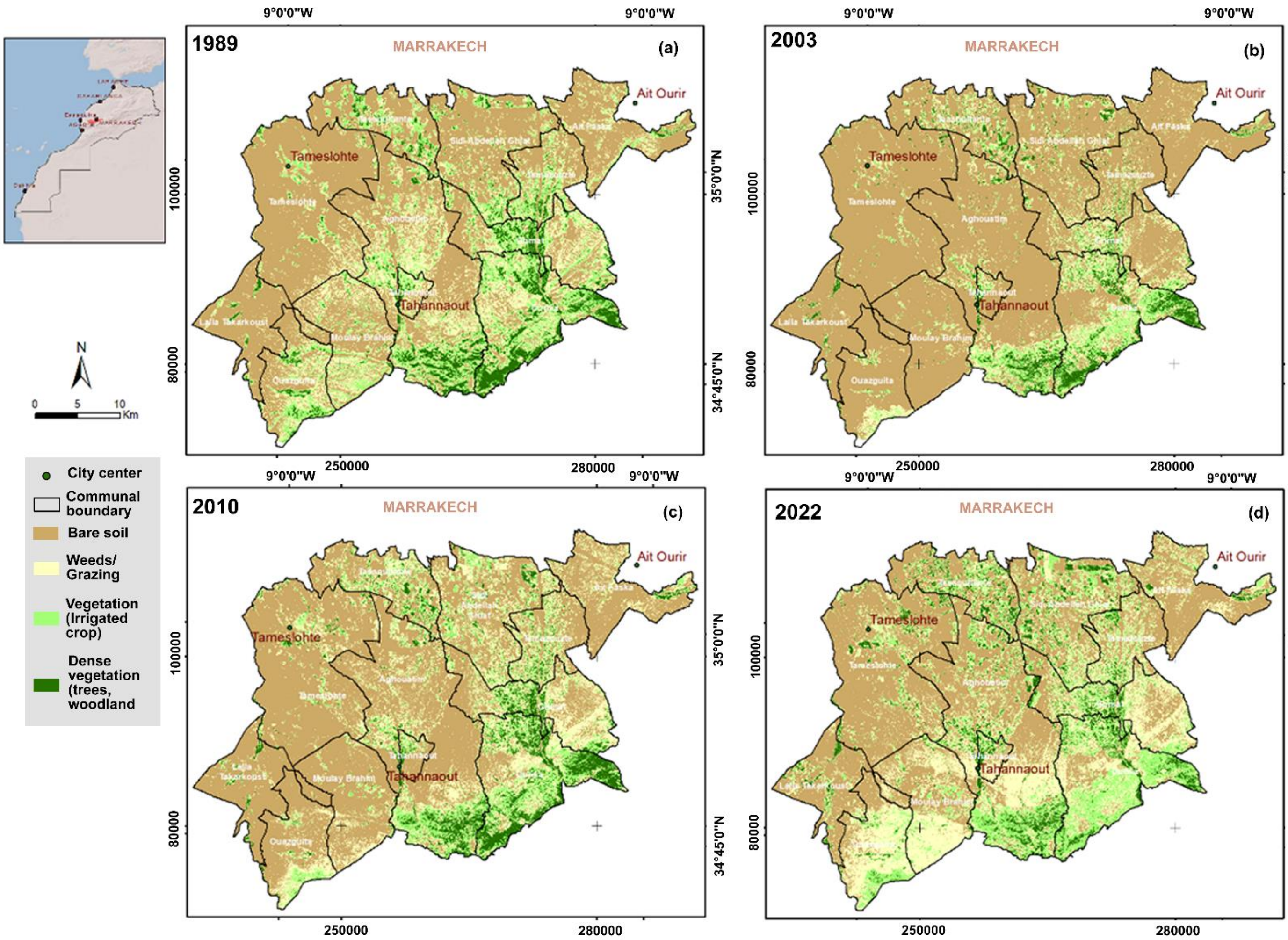

Figure 3. Evolution of land cover in the Western High Atlas Piedmont across decades. Panel (a) presents the land cover map for the year 1989, utilizing data from SPOT 1 satellite imagery. (a) Time series of land cover maps for 1989 (SPOT 1), (b) time series of land cover maps for 2003, (c) time series of land cover maps for 2010 (SPOT 5), and (d) time series of land cover maps for 2022 (Sentinel 2).

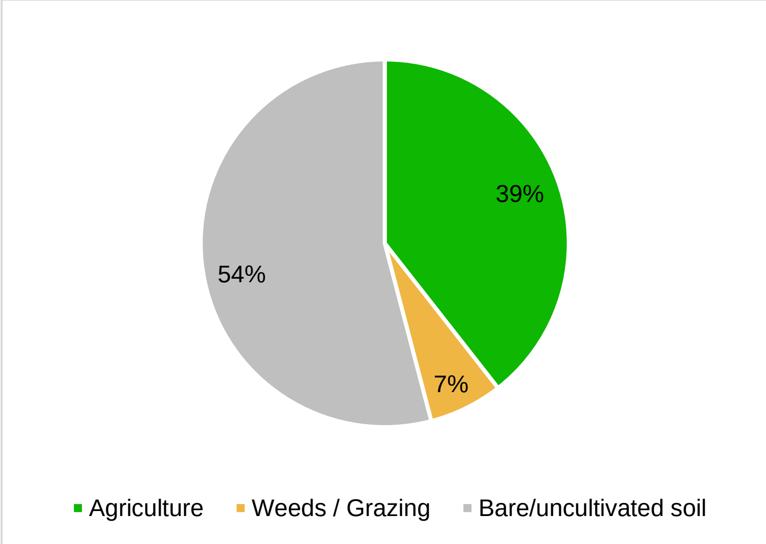

Figure 4. Share of Change in Land use Due to Tourism Investment.

3.1. Spatial Distribution of Tourism Investments by Origin

The maps produced show the uneven distribution of investment. Figure 5 shows a high concentration of tourism investment near the urban perimeter of Marrakech located in the communes of Tassoultante and Aghouatim. This concentration is explained in part by the lack of availability of undeveloped land in Marrakech, which has led to a strong demand for land and opened up investment opportunities in the tourism sector (Kurniawansyah *et al.*, 2023; Stapane *et al.*, 2023).

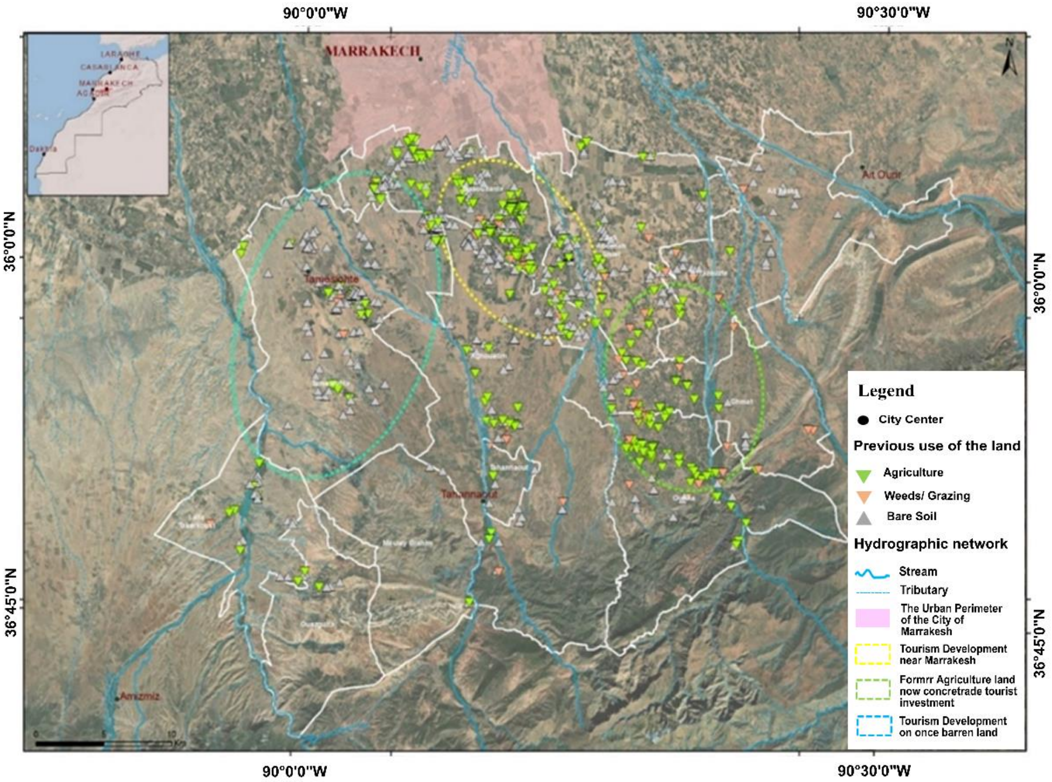

Figure 5. The spatial distribution of tourism investment by land origin.

In the eastern part of the study area, a more even spread of tourism investment was observed, originating from land previously used for agricultural purposes (Basuki *et al.*, 2022). The abundance of this category was attributed to the flourishing agricultural activity in the communes of Ghmate, Ourika, and Tamazouzte, where water resources, such as Oued Ourika and Issyl and the tributaries, favour development. However, a new investment trend was observed associated with the road infrastructure (Mamirkulova *et al.*, 2020). Figure 6 explains this concentration, which has affected farmland. Provincial road N° P2017 links Marrakech to the natural tourist landscape of Ourika and Sti Fadma.

Figure 6. Example of land-use change and tourism investment implementation in the Northern Piedmont of the Western High Atlas.

3.2. Infrastructure Impact On Tourism Investment Implementation

The west zone was characterised by a concentration of tourism investments on land that was initially unfit for agricultural use. This zone covering the communes of Tameslouht and Agafay has limestone soil not very suitable for agriculture but possesses great potential for tourism (Piotr Migo´n, 2024; Carvalhinho *et al.*, 2024). The Agafay region of Marrakech attracts visitors with a diversity of activities including hiking in desert landscapes, quad biking for adrenaline seekers, and camel riding for an authentic experience. Starry evenings fascinate astronomy enthusiasts and desert camps offer sumptuous moments of relaxation. Agafay is a photographer's paradise due to the presence of breathtaking landscapes.

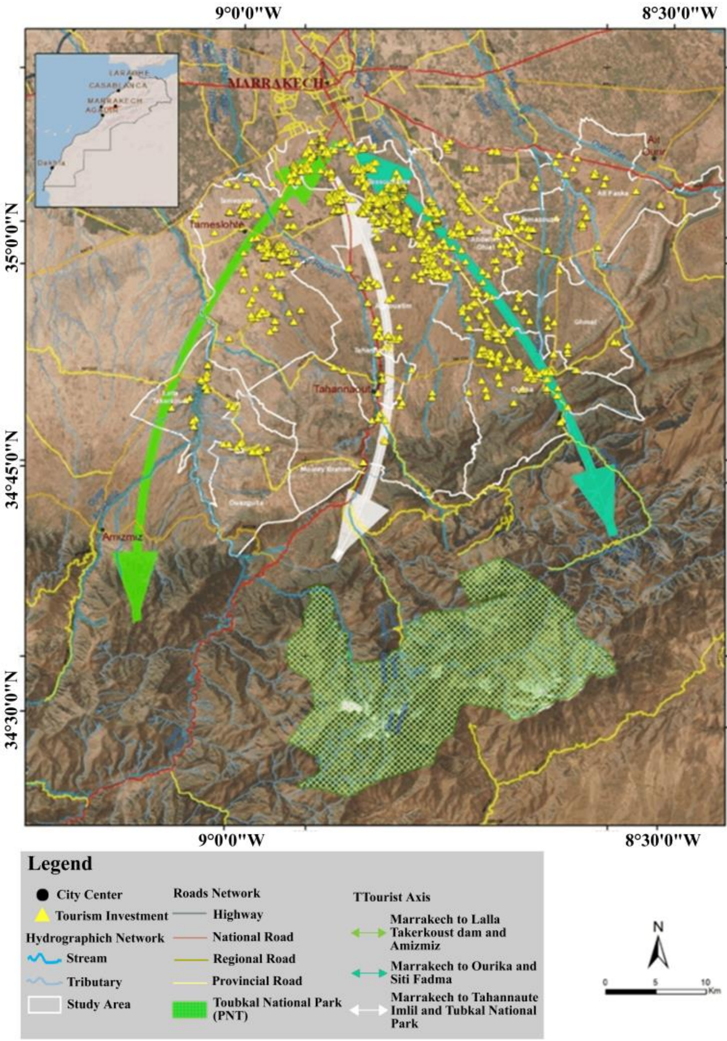

Figure 7. Map of tourist axis according to the distribution of tourist investment.

This type of tourism investment remains closely associated with basic infrastructure, particularly the road network. Figure 7 summarises the main roads that concentrate tourism investment, specifically those leading from Marrakech to:

- Ourika and Sti Fadma and high Atlas Mountains on provincial road N° P2017.
- Tahannaoute and Toubkal National Park (PNT) on national road N°7.
- Towards Lalla Takerkoust dam and Amizmiz centre on provincial road N°P2009.

Road infrastructure has a significant impact on the implementation of tourism investment and accessibility to areas with great potential (Adhuze *et al.*, 2023; Valeriani *et al.*, 2020). Figure 8 shows the distribution of tourism investment by distance to roads and accessibility.

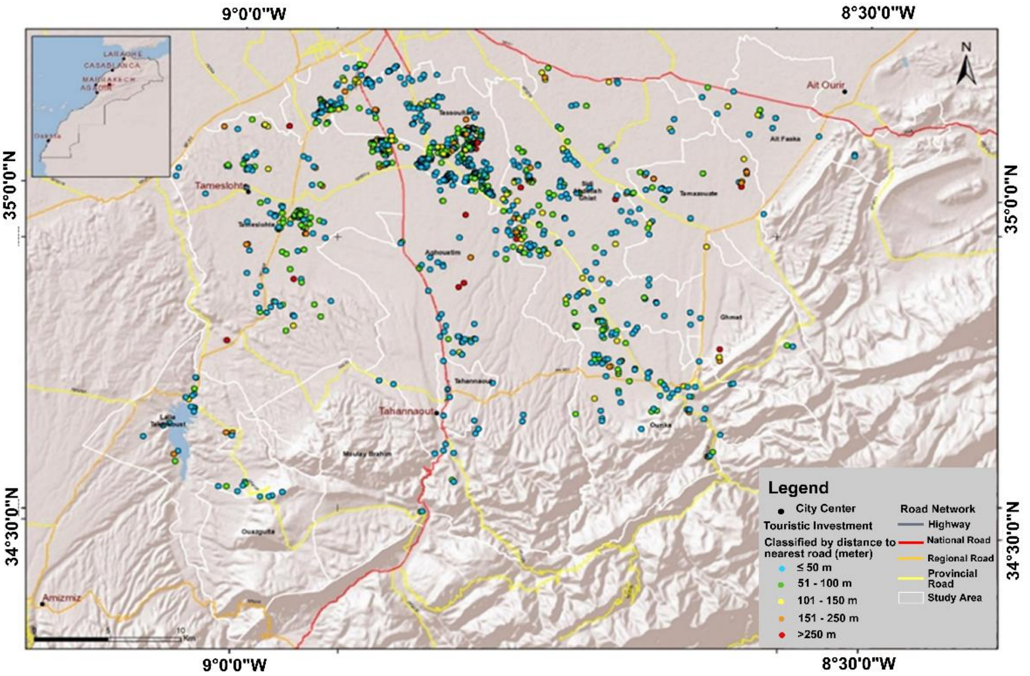

Figure 8. Trend of tourism investment classified by distance to the nearest road in the Northern Piedmont of the Western High Atlas.

This study found a highly compelling and statistically significant relationship in the analysis of tourism investment in relation to road distance (Chavan & Bhola, 2013). The strong correlation between the presence of road infrastructure and tourism investment was indicated by the significant R-squared value (R^2) of 0.9671 (Figure 9).

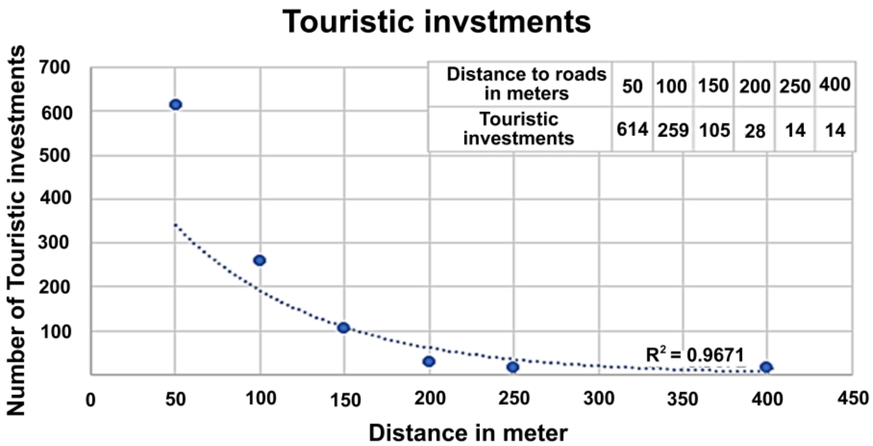

Figure 9. Relationship between road distance and tourism investment in the Northern Piedmont of the Western High Atlas.

This R^2 value signifies that approximately 96.71% of the variability in tourism investment in the Northern Piedmont of the Western High Atlas could be explained by road distance in the regression model. In simpler terms, the proximity to road infrastructure is an exceptionally powerful predictor of tourism investment in this specific geographic region. The convenience and accessibility provided by road infrastructure play a significant role in influencing the distribution of tourism investment (Maziliauske, 2024).

3.2. Discussion

The analysis underscores the crucial role of road infrastructure as a driving force behind tourism investment, emphasising the need for decision-makers, investors, and regional planners to consider road accessibility in guiding the strategic development of tourist destinations (Shen, 2024). A well-developed road network is shown to attract higher tourism investment, ultimately enhancing the region's overall appeal and economic potential. Moreover, the practical implications of spatial analysis were significant, enabling the identification of spatial concentrations of tourism investment and offering insights into basic infrastructure as well as local land suitability (Mo Fan *et al.*, 2024; G. Dong *et al.*, 2021). This information can be used to better target resources and efforts to address land-use change issues (Stathopoulos *et al.*, 2023). Furthermore, spatial analysis provides a solid foundation for future studies aimed at understanding the underlying causes of spatial distributions in tourism investment (Robinson, 2018).

This spatial analysis has certain limitations, for example, the spatial land data were sourced from satellite imagery and field visits, which might contain measurement errors or biases. In addition, the method used was based on specific assumptions, capable of influencing the results. Due to data constraints, this study did not take into account certain important variables related to the type of land in Morocco. It is essential to take the limitations into account when interpreting the results of the analysis.

4. Conclusion

This comprehensive analysis showed the significant impact of tourism investment on the evolving landscape of the Northern Piedmont of the Western High Atlas. As fertile farmland experiences a transformative shift into tourist destinations, concerns arise regarding environmental sustainability and the welfare of local communities. This study underscored the critical importance of a nuanced method to tourism development, with a particular focus on the intricate interplay of land-use and cover.

A dedicated examination of road accessibility and statistical correlation with tourism investment showed a compelling relationship. The significant R-squared value of 0.9671 underlined the indispensable role of well-connected road infrastructure in shaping the distribution of tourism investment in the region. This statistical significance demonstrates the symbiotic relationship between tourism development and a well-developed road network.

Considering the future trajectory for the Northern Piedmont of the Western High Atlas, this study underscored the importance of integrating sustainable practices into tourism planning. The benefits of tourism development must coincide harmoniously with environmental preservation as well as the socio-economic well-being of local communities. Moreover, the statistical insights into the correlation between road accessibility and tourism investments offer a strategic foundation for future decision-making. This study advocates for continued investigations to deepen the current understanding of intricate dynamics. Collaborative efforts between stakeholders and additional investigation attempts are needed to make tourism become a force for positive transformation. In this vision, economic prosperity coexists with ecological health while preserving the region's unique cultural heritage.

Acknowledgements

The authors would like to acknowledge two anonymous reviewers who gave constructive feedback.

Author Contributions

Conceptualization: Zamzami, H. A., Elaanzouli M., Zahrani A., Saidi J., Boumeaza T.; **methodology**: Zamzami, H. A., Elaanzouli M., Zahrani A., Saidi J., Boumeaza T.; **investigation**: Zamzami, H. A., Elaanzouli M., Zahrani A., Saidi J., Boumeaza T.; **writing—original draft preparation**: Zamzami, H. A., Elaanzouli M., Zahrani A., Saidi J., Boumeaza T.; **writing—review and editing**: Zamzami, H. A., Musiyam M.; **visualization**: Zamzami, H. A., Zahrani A.. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

Data availability

Data is available upon Request.

Funding

This research received no external funding.

References

Abdelfadel, F. (2021). Geomorphological And Hydrodynamic Characterization Of The Bouanane Basin (Eastern Upper Guir, High Atlas Of Morocco). *Environmental Science, Geology, Geography*, 5(3), 644-655. doi: 10.48421/IMIST.PRSM/ewash-ti-v5i3.26575.

Adhuze, O., Adewole A., and Adeaga O. (2023). Infrastructure As Drivers For Economic Growth: A Way To Advancing Tourism. *International Journal Of Latest Technology In Engineering, Management & Applied Science*, 12(9), 86-93. doi: 10.51583/Ijltemas.2023.12908.

Alexandre, R., Barata P., Ara G., Bento N. L., Santana L. S., Marin D. B., Mattos D. G., Schwerz F., Rossi G., Conti L., and Bambi G. (2024). UAV-Based Vegetation Indices to Evaluate Coffee Crop Response after Transplanting Seedlings Grown in Different Containers. *Agriculture Article*, 14(136), 1–20. doi: 10.3390/agriculture14030356.

Ali, T., Marc, B., Omar, B., Soulaimane & K., Larbi, S. (2021). Exploring Destination's Negative E-Reputation Using Aspect-Based Sentiment Analysis Approach: Case Of Marrakech Destination On Tripadvisor. *Tourism Management Perspectives*, 40, 100892. doi: 10.1016/J.Tmp.2021.100892.

Basuki, B., Budiman, S. A., Mutmainnah, L., & Rosyady M. G. (2022). Soil Damage Potential Index Based on Weighting Scoring Analysis and Utilization of Geographical Information Systems. *Jurnal Teknik Pertanian Lampung (Journal of Agricultural Engineering)*, 11(4), 601. doi: 10.23960/jtep-l.v11i4.601-616.

Bajocco, S., Ginaldi, F., & Bregaglio, S. (2022). On The Use Of NDVI To Estimate LAI In Field Crops: Implementing A Conversion Equation Library. *Remote Sensing*, 14(15), 3554. doi: 10.3390/rs14153554.

Bégué, A., *et al*. (2020). Atmospheric Correction Of Satellite Imagery For Improved Land Surface Monitoring. *Remote Sensing Of Environment*, 113(23), 1-12. doi:10.1029/2007JD009662.

Carvalhinho, L., Pereira, E., Durão, R., & Rosa, P. (2024). Assessment of recreational and tourist cycling routes. Case study in the West Region of Portugal. *Journal of Outdoor Recreation and Tourism*, 45(1), 100729. doi: 10.1016/j.jort.2023.100729.

Chen, J. (2008). *A Comparison Between NDVI And SAVI For Vegetation Spatial Information Retrieval Based On ASTER Images: A Case Study Of Huadu District, Guangzhou*. Retrived From https://Api.Semanticscholar.Org/Corpusid:130750765.

Chavan, R. R., and Bhola S. S. (2013). Assessing Tourist Infrastructure of the Satara District: The Views of Visitors. *SSRN Electronic Journal*, 2(3), 92–97. doi: 10.2139/ssrn.2315633.

Foody, G. M. (2002). Remote Sensing Of Land Use And Land Cover Change. *Remote Sensing Of Environment*, 80(1), 1-23. doi: 10.1016/S0034-4257(01)00093.

Dong, G., Ge, Y., Jia, H., Sun, C., & Pan, S. (2021). Land use multi-suitability, land resource scarcity and diversity of human needs: A new framework for land use conflict identification. *Land*, 10(10), 1003. doi: 10.3390/land10101003.

Glyptou K. (2022). Operationalising Tourism Sustainability at the Destination Level: A Systems Thinking Approach Along the SDGs. *Tourism Planning and Development*, 21(1), 95–121. doi: 10.1080/21568316.2022.2069150.

Gomih, S., Leporelli, E., Martino, M., & Santi, G. (2021). Sustainable Strategies for the Development of UNESCO Sites: The Medina of Marrakech. Sustain. Mediterr. Constr, 13, 153-159.

Hadibasyir, H. Z., Fikriyah, V. N., & Taufiqurrahman, M. I. (2020). Microscale Urban Ecological Condition Mapping Using Landsat 8 Imagery in Semarang City. *La Geografia*, 18(3), 209–220.

Herold, M, De, S. V, Woodcock, C. E, Seto, K. C, Verburg, P. H, & Lambin E. F. (2008). Global Land Cover Change: Recent Trends And Future Trajectories. *Global Environmental Change*, 18(1), 222-235. doi: 10.1016/J.Gloenvcha.2007.09.002.

Higgins-Desbiolles, F. (2018). Sustainable Tourism: Sustaining Tourism Or Something More?. *Tourism Management Perspectives*, 25, 157-160. doi: 10.1016/j.tmp.2017.11.017.

Kurniawansyah, A., Susiloningtyas, D., & Manessa, M. D. M. (2023). Suitability of Mangrove Tourism Areas in Cilamaya Wetan District, Karawang Regency. *Forum Geografi*, 37(1), 10–23. doi: 10.23917/forgeo.v37i1.19852.

Khusnani, A., Husein, R., Jufriansah, A., Thalo, O. W. J., Rahmawati, K. D., Fitri, M., & Adina, C. A. (2023). Identification of Understanding of Disaster Preparedness in the School Environment. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, 5(3), 233-248. doi: 10.23917/ijolae.v5i3.22974

Landsat Normalized Difference Vegetation Index. (2023). *U.S. Geological Survey*. Landsat Missions. Retrived From Www.Usgs.Gov/Landsat-Missions/Landsat-Normalized-Difference-Vegetation-Index.

Lee, U. J., Kim, M. J., Kim, E. J., Lee, D. W., & Lee, S. D. (2024). Spatial Distribution Characteristics and Analysis of PM2.5 in South Korea: A Geographically Weighted Regression Analysis. *Atmosphere*, 15(1), 1–18. doi: 10.3390/atmos15010069.

Li, Y., Liu, X., Liu, M., Wu, L., Zhu, L., Huang, Z., Xue, X., & Tian, L. (2024). Historical Dynamic Mapping of Eucalyptus Plantations in Guangxi during 1990 – 2019 Based on Sliding-Time-Window Change Detection Using Dense Landsat Time-Series Data. *Remote Sensing*, 16(744), 1–21. doi: 10.3390/rs16050744.

Ma, D., Sun, D., & Wang, Z. (2024). Exploring the Rural Revitalization Effect under the Interaction of Agro-Tourism Integration and Tourism-Driven Poverty Reduction: Empirical Evidence for China. *Land*, 13(60), 1–24. doi: 10.3390/land13010060.

Makkonen, T., & Williams, A. M. (2024). Cross-border tourism and innovation system failures. *Annals of Tourism Research*, 105, 103735. doi: 10.1016/j.annals.2024.103735.

Mamirkulova, G., Mi, J., Abbas, J., Mahmood, S., Mubeen ,R., & Ziapour A. (2020). New Silk Road infrastructure opportunities in developing tourism environment for residents better quality of life. *Global Ecology and Conservation*, 24(1), 01194. doi: 10.1016/j.gecco.2020.e01194.

Mattah, P. A. D., Akwetey, M. F. A., Abrokwah, S., Prah, P., Tuffour, D. K., Aheto, D. W., & Subramanian, S. (2024). Perspectives on Drivers of Biodiversity and Environmental Changes in the Keta Lagoon Ramsar Site of Ghana. *Sustainability*, 16(2), 1–19. doi: 10.3390/su16020666.

Maziliauske, E. (2024). Innovation for sustainability through co-creation by small and medium-sized tourism enterprises (SMEs): Socio-cultural sustainability benefits to rural destinations. *Tourism Management Perspectives*, 50(1), 101201. doi: 10.1016/j.tmp.2023.101201.

Mohamed, H., & Rachid, D. (2019). Assessing sustainable tourism: Trends and efforts in Essaouira in Morocco as a coastal city. *International Journal of Sustainable Management and Information Technologies*, 5(1), 23-28.

Mo Fan, Massoomeh, H. M. A,. Abdullah, M. J. M. T. (2024). Using a Space Syntax Approach to Enhance Pedestrians Accessibility and Safety in the Historic City of. *Urban Science (MDPI)*, 8(6), 1–23. doi: 0.3390/urbansci8010006.

Musiyam, M., Jumadi, J., Wibowo, Y. A., Widiyatmoko, W., & Hafida, S. H. N. (2020). Analysis of flood-affected areas due to extreme weather in Pacitan, Indonesia. *International Journal of GEOMATE*, 19(75), 27-34. doi: 10.21660/2020.75.25688

Nosavan, J., Moreau, A., & Hosford, S. (2020). SPOT World Heritage Catalogue: 30 Years Of SPOT 1-To-5 Observation. *Presented At EGU General Assembly*. doi: 10.5194/Egusphere-Egu2020-8275.

Patil, P. P., Jagtap, M. P., Khatri, N., Madan, H., Vadduri, A. A., & Patodia, T. (2024). Exploration and advancement of NDDI leveraging NDVI and NDWI in Indian semi-arid regions: A remote sensing-based study. *Case Studies in Chemical and Environmental Engineering*, 9(1), 100573. doi: 10.1016/j.cscee.2023.100573.

Peluzio, E. C. R. D. (2024). Application of Path Analysis and Remote Sensing to Assess the Interrelationships between Meteorological Variables and Vegetation Indices in the State of Esp í rito Santo , Southeastern Brazil. *Diversity Article*, 16(90), 1–24. doi: 10.3390/d16020090.

Pengfei, Zhang, Hu, Y., Linlin, X., Wei, G. M. S. (2024). Synergistic relationship or not ? Understanding the resilience and efficiency of the tourism economy : evidence. *Environment, Development and Sustainability*, 26(1), 3793–3817. doi: 10.1007/s10668-022-02858-7.

Piotr, M.E. P.M. (2024). Non-Uniform Distribution of Geoheritage Resources in Geoparks — Problems, Challenges and Opportunities. *MDPI, Resources*, 13(23), 1–22. doi: 10.3390/resources13020023.

Prayag, G., Muskat, B., & Dassanayake, C. (2023). Leading for Resilience: Fostering Employee and Organizational Resilience in Tourism Firms. Journal of Travel Research, 63(3), 659–680. doi: 10.1177/00472875231164984.

Rafik, K. (2023). The Tourism Sector and Territorial Development in Marrakech City - Morocco. *International Journal of Humanities and Educational Research*, 5(4), 253–284. doi: 10.47832/2757-5403.21.16.

Raihan, A. (2024). The influence of tourism on the road to achieving carbon neutrality and environmental sustainability in Malaysia: The role of renewable energy. *Sustainability Analytics and Modeling*, 4(1), 100028. doi: 10.1016/j.samod.2023.100028.

Robinson, B. S. D. T. (2018). Comparison of Statistical Approaches for Modelling Land-Use Change. *Sustainability* ,7(144), 1–33. doi: 10.3390/land7040144.

Román, A., Heredia, S., Windle, A. E., Tovar-Sánchez, A., & Navarro, G. (2024). Enhancing Georeferencing and Mosaicking Techniques over Water Surfaces with High-Resolution Unmanned Aerial Vehicle (UAV) Imagery. *Remote Sensing*, 16(290), 1–18. doi: 10.3390/rs16020290.

Roubil, A. (2022). Groundwater Hydrochemical And Isotopic Evolution From High Atlas Jurassic Limestones To Errachidia Cretaceous Basin (Southeastern Morocco). *Water*, 14(11), 1747. doi: 10.3390/W14111747.

Saha, J., Ria, S. S., Sultana, J., Shima, U. A., Hasan, S. M. M., & Rahman, M. M. (2024). Assessing seasonal dynamics of land surface temperature (LST) and land use land cover (LULC) in Bhairab, Kishoreganj, Bangladesh: A geospatial analysis from 2008 to 2023. *Case Studies in Chemical and Environmental Engineering*, 9(1), 100560. doi: 10.1016/j.cscee.2023.100560.

Sharma, M., Bangotra, P., Gautam, A. S., & Gautam, S. (2022). Sensitivity Of Normalized Difference Vegetation Index (NDVI) To Land Surface Temperature, Soil Moisture And Precipitation Over District Gautam Buddh Nagar, UP, India. *Stochastic Environmental Research And Risk Assessment*, 36(6), 1779–1789. doi: 10.1007/S00477-021-02066-1.

Shen, M. (2024). GIS positioning based on optical sensing detection and simulation of tourism route planning in rural tourism scenic areas. *Optical and Quantum Electronics*, 56(3), 1–22. doi: 10.1007/s11082-023-06049-0.

Sòria-Perpinyà, X., Delegido, J., Urrego, E. P., Ruíz-Verdú, A., Soria, J. M., Vicente, E., & Moreno, J. (2022). Assessment Of Sentinel-2-MSI Atmospheric Correction Processors And In Situ Spectrometry Waters Quality Algorithms. *Remote Sensing*, 14(19), 4794. doi: 10.3390/Rs14194794.

Stapane, V., & Majid, A. M. Z. (2023). How Interaction Tourism Sector And Transport Infrastructure Toward National Income In Malaysia?. International Journal Of. *Economic and finance*, 12(3), 1962-1973. doi: 10.6007/Ijarped/V12-I3/19306..

Stathopoulos, N., Rozos, D., & Vasileiou, E. (2023). Water resources management in Sperchios River Basin, using SWOT analysis. *Journal of the Civil Engineering Forum*, 9(3), 315–328. doi: 10.22146/jcef.7652.

Susila, I., Dean, D., Harismah, K., Dwi, K., & Agus A. (2024). Asia Paci fi c Management Review Does interconnectivity matter ? An integration model of agro-tourism development. *Asia Pacific Management Review*, 29(1), 104–114. doi: 10.1016/j.apmrv.2023.08.00.

Susila, I., Dean, D., Harismah, K., Priyono, K. D., Setyawan, A. A., & Maulana H. (2024). Does interconnectivity matter? An integration model of agro-tourism development. *Asia Pacific Management Review*, 29(1), 104–114. doi: 10.1016/j.apmrv.2023.08.003.

Tong, Y., & Zhang, R. (2022). Investigating the multiple mechanisms of tourism economy affecting sustainable urban development of Chinese cities: based on multi-source data. Environment, *Development and Sustainability*, 26(1), 1781–1808. doi: 10.1007/s10668-022-02785-7.

Turner, B. L., Lambin, E. F & Reenberg, A. (2007) The Emergence Of Land Change Science For Global Environmental Change Research. *Proceedings Of The National Academy Of Sciences*, 104(52), 20666-20671. doi: 10.1073/Pnas.0707395104.

Valeriani, D., Wardhani, R., & Reeve, D. (2020). Infrastructure Readiness To Support Sustainable Tourism Destinations In Bangka Belitung Islands. *International Journal Of Applied Sciences in Tourism and Events*, 4(1), 1-13.doi: 10.31940/Ijaste.V4i1.1908.

Xing, Y., Yang, S., & Jiao, L. (2022). Dual-Collaborative Fusion Model For Multispectral And Panchromatic Image Fusion. *IEEE Transactions On Geoscience And Remote Sensing*, 60(1), 123-135. doi: 10.1109/TGRS.2020.3036625.

Yasemin, Sarıkaya, L, Ezgi, S. T. L. (2024). The Role of Tourism Planning in Land-Use / Land-Cover Changes in the Kızkalesi Tourism Destination. *Land MDPI*, 13(151), 1–27. doi: 10.3390/land13020151

Zhang, B., Tang, B., Zhou, L., & Huang, K. (2021). Study On The Influence Of Road Network On The Spatial Distribution Of Tourism Resources – A Case Study Of The Sichuan-Tibet Scenic Byway. *Converter*, 20(5), 242-256. doi: 10.17762/converter.286.