Socio-ecological transformations of a Moroccan mountain oasis

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Introduction & Methods





Oases in the High-Atlas Mountains of Morocco are facing the effects of climate change and of rapid rural-urban transformation. An interdisciplinary study was conducted to quantify these transformations and understand their causes and consequences in the oasis of Tizi N'Oucheg (**Fig. 1**). Non-destructive methods of remote sensing combined with participatory mapping and interviews were used to quantify vegetation cover and land use patterns.



Figure 1. Oasis of Tizi N'Oucheg in the High-Atlas Mountains of Morocco.

Results & Discussion

1. Vegetation cover

- High vegetation = agricultural area of the oasis and surrounding tree stands, Medium vegetation = shrubs and grass cover used for livestock grazing,
 - *Low vegetation* = bare soil and rocks (**Fig. 2**).
- → High variations in vegetation cover for the same month across the past 7 years (Fig. 3).





Figure 2. Vegetation cover of Tizi N'Oucheg, Morocco in April 2021 and 2022 (Sentinel 2B images processed with QGIS).

Climate change in Morocco is a threat to the sustainability of oasis agriculture.



➢ High vegetation cover was significantly correlated to total precipitation and its seasonal distribution (P≤ 0.05; Fig. 4).
➢ Cultivated crops and grazing

vegetation are highly sensitive to climatic conditions.

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2. Land use



Figure 5. Uncultivated terraces and built-up area in Tizi Oucheg, Morocco from 1972-2022.

 87% of the surveyed households (n=25)
receive remittances
from family members



> Over the last 50 years the uncultivated land area has grown by 70% and the built-up area by 75% (Fig. 5).
> High correlation between uncultivated land area and number of migrated households (P≤ 0.005; Fig. 6).

Figure 4. Annual rainfall and rainy days from 2009-2022 in the region of Tizi N'Oucheg, Morocco (climate-data.org).



Figure 6. Number of migrated households in Tizi N'Oucheg, Morocco from 1972 to 2022.



Most of the newly built-up area relates to touristic infrastructure (Fig. 7).

in Moroccan cities.This income is rarelyinvested inagricultural activities.

Legend Uncultivated land Cultivated land Built-up area River External livelihood opportunities threaten oasis existence.

Figure 7. Land use in Tizi N'Oucheg, Morocco from 1972 to 2022 (CORONA and drone images, processed with QGIS).

Conclusions & Recommendations

The socio-ecological transformation in the High-Atlas mountain oasis of Tizi N'Oucheg is driven by rural push factors of agricultural vulnerability and pull factors of new livelihood opportunities in urban areas. To foster the survival of oasis agriculture as a cradle of Moroccan culture, policies are needed that stimulate the establishment of value chains for oasis products including ecosystem services for tourists.

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