Land cover changes and vegetation dynamics in Northern Niger

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Introduction & Methods

In the last decade effects of urbanization and rapid population growth in West Africa have transformed many oasis systems in the Aïr Mountains of Northern Niger from subsistence agro-pastoral land use forms to market oriented agricultural production. For oases on Mont Bagzam and Timia (**Fig. 1**) GIS and remote sensing (**Fig. 2**) were used to quantify changes in land use and land cover (LULC) These changes were correlated to annual precipitation and livestock numbers.

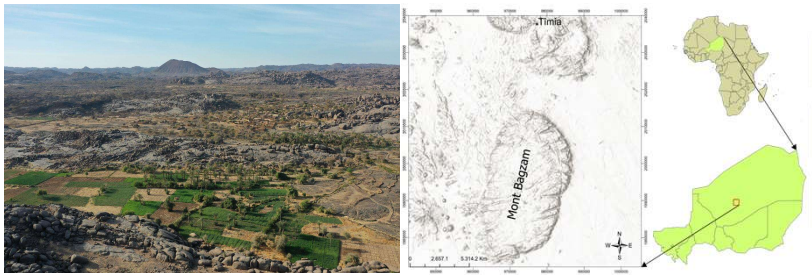

Figure 1. Oasis of Emalawlé, Mont Bagzam (left) and location of the study area (right)

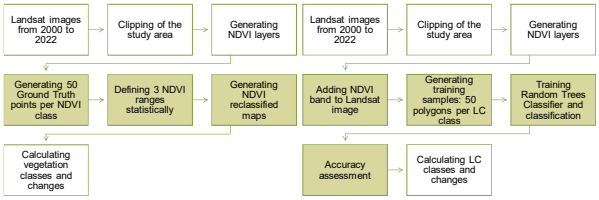

Figure 2. Framework of NDVI classification (left) and Random Forest LULC classification (right) in ArcGIS Pro

Results & Discussion

1. Vegetation Dynamics

- High and medium vegetation areas grew by 1483% and 1290%, respectively (**Fig. 3 & 4**)
- No/low vegetation area decreased by 20% (**Fig. 3 & 4**)
- Livestock numbers and annual precipitation increased by 99% and 195% respectively (**Fig. 4 & 5**)

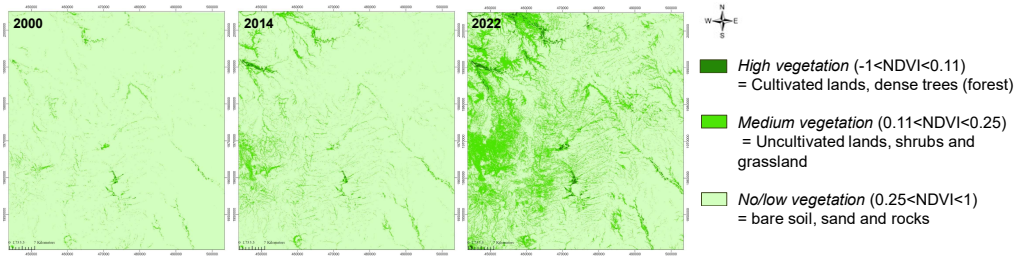

Figure 3. Vegetation cover in September 2000, 2014, and 2022 on Mont Bagzam, Timia, and their surroundings. Landsat 7-8 C2 L2 images processed with ArcGIS Pro)

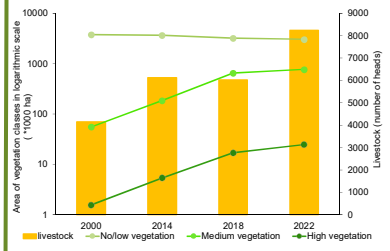

Figure 4. Correlation between livestock and vegetation classes from 2000-2022 on Mont Bagzam and Timia

- Medium and high vegetation areas have a strong positive correlation with livestock numbers (**Fig. 4**)
- High correlation between precipitation and medium/high vegetation areas (**Fig. 5**)
- Contrary, no/low vegetation area is negatively correlated with livestock and precipitation (**Fig. 4 & 5**)

➢ Vegetation depends on precipitation
➢ Livestock numbers depend on the availability of vegetation

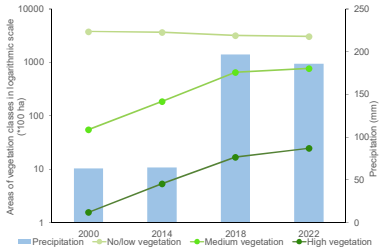

Figure 5. Correlation between precipitation and vegetation classes from 2000-2022 on Mont Bagzam and Timia, Niger.

2. Land Cover Changes

- Agricultural land and areas of natural vegetation increased by 273% and 89%, respectively (**Fig. 7**)
- Bareland decreased by 24% (**Fig. 7**)

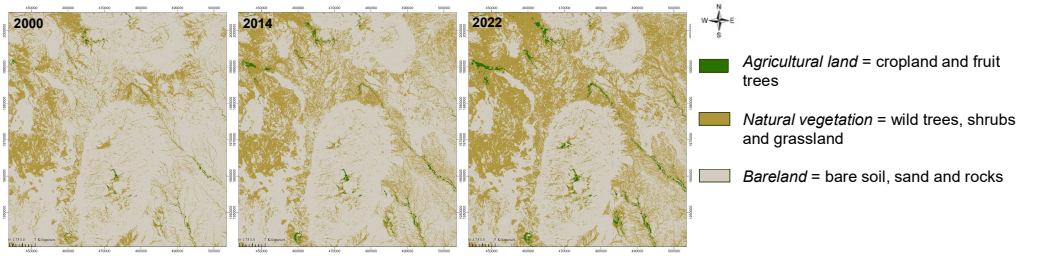

Figure 6. LULC Random Forest maps of September 2000, 2014, and 2022 on Mont Bagzam, Timia, and their surroundings. (Landsat 7/8 C2 L2 images processed with ArcGIS Pro).

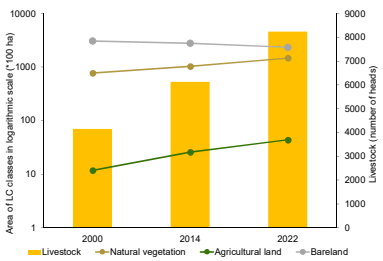

Figure 7. Correlation between livestock and LC classes from 2000-2022 on Mont Bagzam and Timia, Niger

- Agricultural land and natural vegetation are highly correlated to livestock numbers and precipitation (**Fig. 7 & 8**)
- Conversely, there is a negative correlation between bareland and livestock numbers/precipitation (**Fig. 7 & 8**)

➢ Transformation of bareland into cultivated irrigated areas (through wells) for agricultural market production (important source of income)

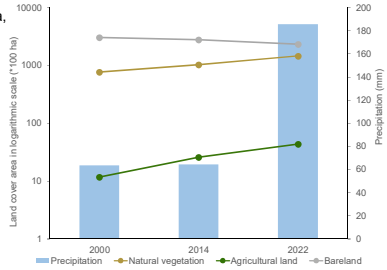

Figure 8. Correlation between precipitation and LC classes from 2000-2022 on Mont Bagzam and Timia

Conclusions & Recommendations

The overall greening of the landscape in the Aïr Mountains of Northern Niger is a result of changes in land use, livestock numbers and climatic conditions. The changes are encouraging for local livelihoods, but they also call for vigilance. Potential water scarcity due to the expansion of irrigated agricultural land, overgrazing, and soil degradation threaten these fragile agro-ecosystems. To ensure the longevity of the positive vegetation trends, potential negative impacts of land use intensification must be monitored.

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