A Statistical Comparison of the Physical Characteristics of Terracing in the Basin of Mexico

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Introduction

The Basin of Mexico has been home to several of the most significant cultural groups in Mesoamerican history, including Teotihuacan, the Toltec Empire, and the Aztec Empire. Increasing population pressure and political instability during different periods pushed the population to inhabit increasingly marginal areas, such as hilltops. Settlement of these areas was facilitated by terracing, which can create level surfaces and control soil and water transportation. Previous studies of terracing in the Americas have found that terraces often occur within a limited range of environmental characteristics (Doolittle 2004; Hirth 2000; Sandor 1995; Kruse 2007). This range may indicate where terracing is the most productive or efficient. Determining what this range is for the Basin of Mexico may provide an insight into the agricultural and land-use decision-making of ancient groups. For this project, I will be focusing on four hilltops: Cerro Ahumada, Cerro Gordo, Cerro San Lucas, and Cerro Chiconautla. These hilltops were possibly occupied and terraced before Spanish contact.

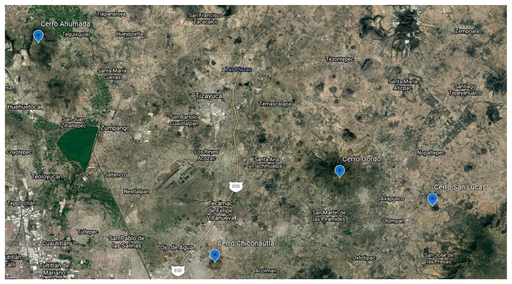

Figure 1. Google Earth Image showing the location of the four hilltops in relation to each other.

Research Questions

Does terracing occur within a certain range of environmental variables in the Basin of Mexico?

Are terrace characteristics specific to each hillslope?

Methods

Terrace Mapping:
Terraces were mapped for each site using the world base map in ArcGIS. The environmental characteristics associated with each terrace: slope, aspect, vegetation cover, and soil moisture; were measured and compared to the total area of the hill. Slope and aspect were calculated using 5m Lidar DEM data retrieved from the INEGI website. Vegetation cover(NDVI) and soil moisture (NDMI) were calculated using 15m multiband Geo-Eye data from the USGS website. Data for Cerro Gordo was only collected for the northern side of the hillslope because spatial data was lacking for the other half. Data was collected for terraced and total hill area for comparison.
Spatial Analysis:
Spatial analysis was conducted using R software. I determined if there was any correlation between the different variables associated with terraced areas. Terraced and non-terraced areas were then compared to determine if terraces occurred within a specific range of the total hill area. Finally, I created a multi-linear regression model to determine if the site could be predicted based on its terrace characteristics.

Results

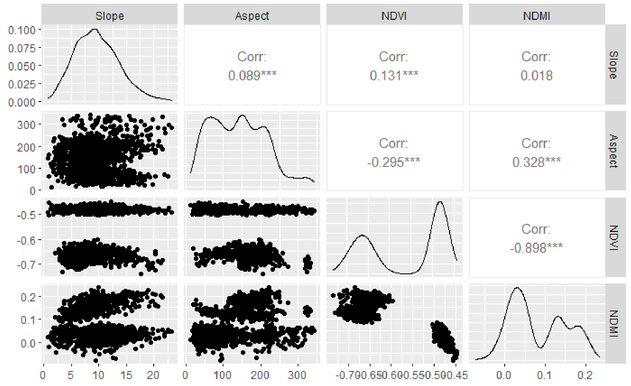

Figure 2.Correllogram showing correlation values and distribution of data for different variables

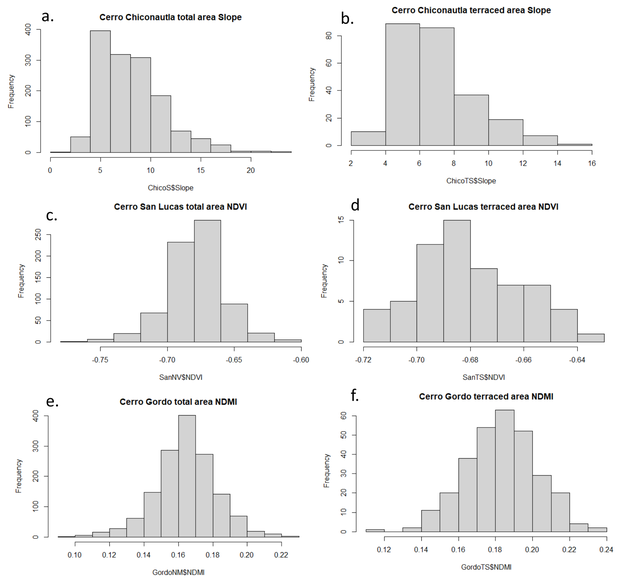

Figure 3 a-f. Histograms of different hills and variables comparing total(left) and terraced(right) areas.

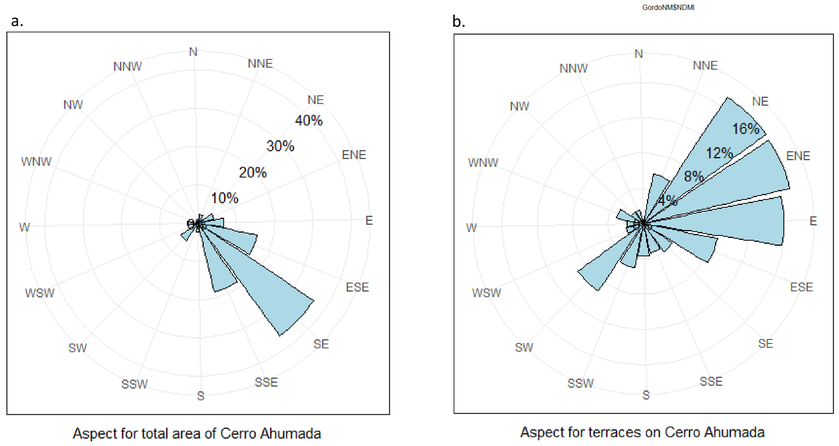

Figure 4a. & b. Rose diagrams for aspect of total and terraced areas of Cerro Ahumada

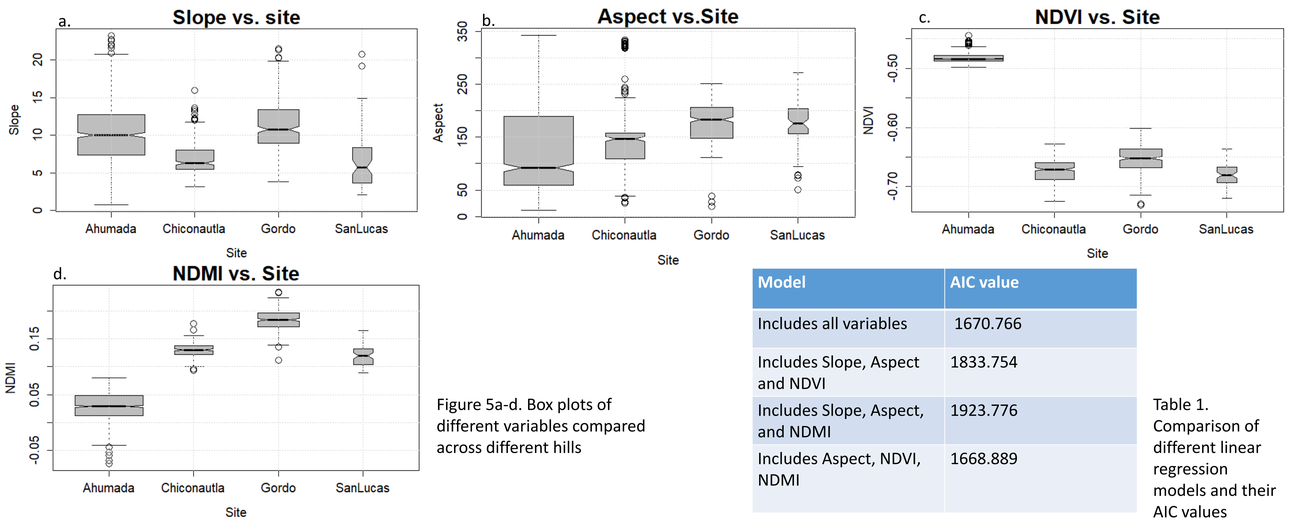

Figure 5a-d. Box plots of different variables compared across different hills

Model	AIC value
Includes all variables	1670.766
Includes Slope, Aspect and NDVI	1833.754
Includes Slope, Aspect, and NDMI	1923.776
Includes Aspect, NDVI, NDMI	1668.889

Table 1. Comparison of different linear regression models and their AIC values

Conclusions

- All variables appear to be independent of each other except 2. NDVI and NDMI are strongly negatively correlated, which was expected based on previous analysis of Cerro Ahumada terraces (Villasenor Iribe 2020). Aspect is also slightly correlated to both of these variables.
- Overall terraces appear to occur within a limited range of the total area for each hill. Terraces also mostly occur in slopes of <20%, which supports previous analysis(Villasenor Iribe 2020) that suggests this marks a possible limit of productivity.
- Terraces also appear to occur mostly within a range of NE-SE aspect.
- There does appear to be an issue with the NDVI and NDMI calculated values for the total hill areas, which may have been caused by the fishnet sampling process.
- NDVI and NDMI values for Cerro Ahumada terraces also occur outside of the values for the other terraced areas which further supports that an error may have occurred while calculating these values.
- The predictive model that worked the best did not include slope, but it only did slightly better than the model that included all variables. This may indicate that there is standard range of slope for terracing within this region.

Future Work

Future analysis of Terrace use will include:

- Reanalysis of these variables and terraces with higher resolution spatial data.
- Extensive sampling of other terraced and not terraced hilltops in the Basin of Mexico
- Excavation of terraced areas to confirm their presence.
- Excavation of terraces to determine their dates of construction and use. This may help determine if there are differences between ancient and modern land management strategies.
- Inclusion of other variables that impact may agricultural production, like soil type.
- Creation of a Predictive model that includes terrace absence and presence for the region.
- Comparison with other regions of Mexico to determine if terrace construction and use was unique for the Basin of Mexico.

Works Cited

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