Drought Risk Monitoring and Dynamics in Afar Region Rangeland, Ethiopia, Horn of Africa Using Earth Observation Data

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INTRODUCTION

The arid and semi-arid lands of the Horn of Africa, including Ethiopia's Afar rangeland region, are affected by drought, resulting in increased poverty, food insecurity, and livelihood vulnerabilities growing regions of Ethiopia. Rangeland degradation in Ethiopia is a significant environmental challenge with far reaching consequences for both ecosystems and human livelihoods. Multiple factors contribute to this degradation, including overgrazing, deforestation, soil erosion, and climate change. As a result, vegetation cover declines, soil fertility diminishes, and biodiversity decreases, impacting the productivity of livestock and exacerbating food insecurity and poverty among pastoral communities [1,2,3]. Urgent action is required to implement sustainable land management practices, promote community-based conservation initiatives, and strengthen policy frameworks to address rangeland degradation and safeguard the resilience of pastoralist rangeland's ecosystems.

MATERIALS AND METHODS

In this study, we employed innovative methodologies utilizing Earth Observation (EO) data to analyze rangeland cover dynamics in the Afar pastoral region of Ethiopia, with a focus on understanding changes in relation to climate variability. Satellite imagery from the years 2000, 2010, and 2020 was acquired from the United States Geological Survey (USGS) and processed to investigate land use and land cover (LULC) changes over time. A supervised image classification approach was applied using the maximum likelihood algorithm in ERDAS Imagine software to categorize different LULC classes, such as grasslands, croplands, and bare land. To ensure the accuracy of the classification, ground truth data were collected through field surveys using GPS instruments, which were then integrated for validation purposes.

RESULTS AND DISCUSSIONS

Over the past decade a novel analytical approach that combines satellite data and statistical modeling has been used to quantify rangeland degradation. The results reveal a significant decline in grassland cover in the Afar pastoral region, shrinking from 24,617.4 km^2 in 2000 to 10,105.4 km^2 by 2020 (Table 1 and figure 1). On the contrary, bare land consistently expanded over the same period. Even though its severity levels varied in different years there was extreme drought recorded in 2005, 2009, 2011 and 2015.This environmental degradation forces Pastoralists to migrate both within and beyond their national borders in search of pasture and water. This movement often leads to conflicts, which frequently require regional intervention to address or prevent.

Table 1. Areas and percentages of Land use and land cover classes for the years 2000, 2010, and 2020

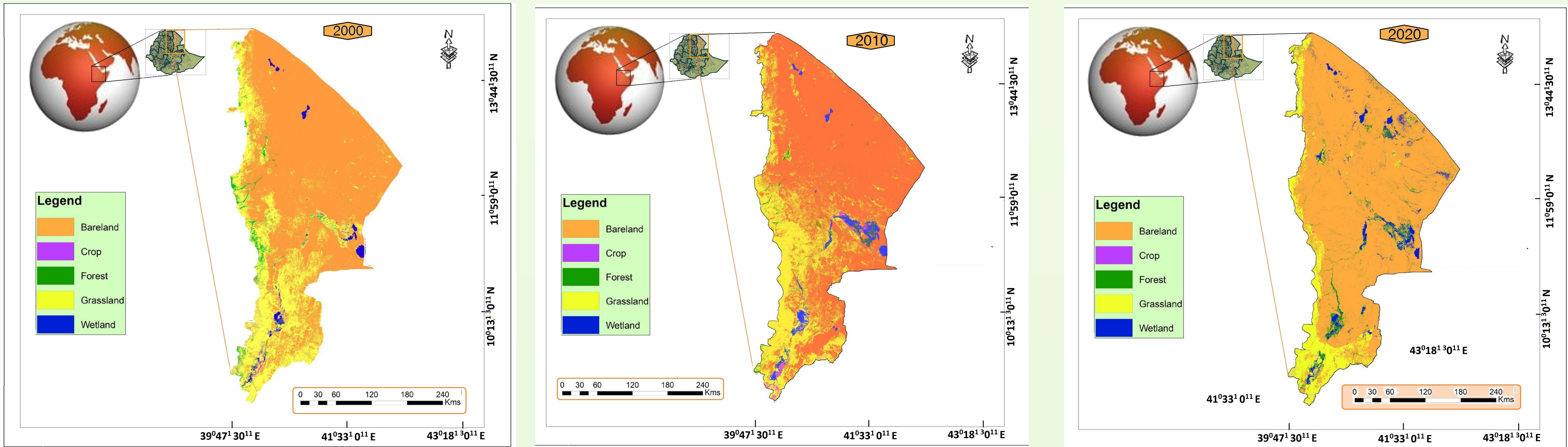| Classes	2000		2010		2020	
	Area (Sq.km)	Percent (%)	Area (Sq.km)	Percent (%)	Area (Sq.km)	Percent (%)
Forest	1843.18	1.89	1374.68	1.41	2911.97	2.99
Grassland	24617.40	25.32	23428.31	24.10	10105.40	10.39
Cropland	569.22	0.58	689.02	0.70	723.97	0.74
Bare land	69000.53	70.99	69349.43	71.35	80275.37	82.59
Wetland	1160.36	1.19	2270.47	2.33	3188.36	3.28
Total	97190.69	100.00	97190.69	100.00	97190.69	100.00

Figure 1. Land use and land cover types in Afar rangelands between 2000 and 2020.

RECOMMENDATIONS

☞ Efforts should be focused on restoring degraded ecosystems and enhancing water conservation practices in the Pastoral region.

☞ The use of Earth observation and remote sensing data for monitoring environmental changes is vital. Policymakers should invest in these technologies to enhance the accuracy of data for decision making related to drought resilience and sustainable development planning.

☞ Establishing and strengthening early warning systems for drought can help pastoralists prepare in advance.

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