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Analyzing the Variability of Wildfire Susceptibility in Queen Elizabeth National Park - Uganda

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Abstract:

This study was carried out to determine the variability of wildfire susceptibility of Queen Elizabeth National Park (QENP), a protected area in Western Uganda. Wildfires have prevailed in protected areas of Sub-Saharan Africa (SSA) including QENP, partly due to a conducive climate comprising of rhythmic wet and dry seasons, as well as large expanses of combustible savannah vegetation but also due to poor wildfire management. Poor wildfire management in QENP has in part been compounded by the lack of updated information about the behavior and pattern of fires as well as the areas susceptible to wildfires, hence the need to bridge this information gap.

To determine the variability of wildfire susceptibility, an inventory of fires was developed using MODIS and VIIRS active fire data for a 6 and a half year-period from January 2015- June 2021. Wildfire conditioning factors including altitude, aspect, NDVI, Precipitation, Proximity to lakes, rivers and settlements were also considered. The relationship of these conditioning factors with the obtained fires was characterized using Weights of Evidence (WOE) statistical method and subsequently used to model areas susceptible to wildfires within QENP.

Results of the study revealed that fire occurrences were seasonally dependent with most fires observed in dry seasons because of accumulation of dry flammable vegetation. NDVI, altitude and proximity to lakes were the conditioning factors that exhibited the highest correlation categories with the occurrence of fires. This was attributed to water stress in vegetation, physiographic influence and socio-economic activities of the fishing villages around the lakes. WOE achieved 70.3% and 69.9% success rates as validated using Receiver Operating Characteristics - Area Under the Curve method for VIIRS and MODIS derived models respectively which implied that the modeling results were reliable. Wildfire susceptibility maps were developed with 5 susceptibility levels obtained as very high, high, moderate, low, very low. 19% of the study area was classified with susceptibility level as very high and 20% as high with the remaining 61% as moderate, low and very low.

The 19% of the study area with very high susceptibility is thereby the most prone to wildfires and these wildfires peak in the periods of January-March and June-August. This effectively narrowed down the areas and periods in which to focus application of fire prevention and the limited suppression resources. This information will help managers to optimally allocate fire management resources to efficiently mitigate against wildfires within QENP. As a recommendation, the study could be up-scaled for development of early warning systems that can detect conditions potentially leading to causation of wildfires so that advance preparations could be made to prevent them.