GIS-Based Tree Mapping Near Power Lines: A Geospatial Technology Approach to Wildfire Hazard Mitigation and Grid Resilience

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Abstract:

Trees growing in proximity to overhead power lines pose a dual seasonal threat to electrical infrastructure and public safety. In the dry season, contact between vegetation and live conductors — whether through direct touch or electrical arcing — is a leading ignition source for wildfires in Mediterranean climates; fires of this origin are on average ten times larger than other wildfire types. In winter, storms, high winds, and snow loads cause trees to fall on power lines, resulting in widespread outages, infrastructure damage, and significant liability exposure for utilities. Effective GIS disaster management and risk reduction therefore requires year-round identification and monitoring of hazardous trees along transmission corridors. This is further complicated by an inherent tension between hazard mitigation and forest conservation: trimming or removing trees near power lines directly conflicts with the goals of nature protection authorities responsible for preserving forest cover and biodiversity. Resolving this conflict requires precise spatial data — identifying only those individual trees that genuinely threaten the lines, rather than applying broad clearance zones that cause unnecessary ecological damage. Despite this need, locating hazardous trees has traditionally relied on manual field surveys — a slow, costly, and spatially limited process that cannot support rigorous spatial risk analysis or evidence-based spatial planning at scale.

This paper presents a geospatial technology framework developed by Ecolo-GIS for the Israel Electric Corporation (IEC) that replaces manual inspection with systematic, GIS-based spatial risk analysis. The methodology integrates high-resolution aerial orthophotography and Digital Surface Models (DSM) with machine learning classification to map individual trees, estimate canopy heights, and distinguish between vegetation types (conifers, broadleaf trees, and shrubs). The algorithms developed by Ecolo-GIS enable precise horizontal and vertical proximity analysis for three categories: high, extra-high, and ultra-high voltage. Dead and desiccating trees within the line corridor were mapped using the NDVI index, providing critical inputs for hazard mapping and targeted fire risk management.

Applied initially across four pilot sites in Israel's Jerusalem District (~30 km of lines), the analysis identified 176 trees with potential for direct conductor contact, with significant site-to-site variation.