Field Surveys for Biomass Assessment in African Savanna Woodlands

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Abstract:
Most rural and some low-income urban households in southern Africa rely on fuelwood and charcoal to meet their domestic energy demands, targeting specific tree species for their calorific value. The lack of quantitative data on extractable standing woody biomass makes it difficult for energy planners to ascertain the sustainability of exploiting such resources. Large scale estimation of biomass using ground-based methods is both tedious and time-consuming. Optical remote sensing techniques are constrained by adverse atmospheric conditions such as clouds and haze, and in any case survey only the upper surface of the vegetation canopy. Recent advances in synthetic aperture radar (SAR) remote sensing and Global Positioning Systems (GPS) technologies coupled with geographic information systems (GIS) offer innovative ways to quantify and assess available woody biomass. Tree species heterogeneity in savanna woodlands requires training data with minimal target-to-image noise to distinguish tree vegetation on SAR imagery. The absolute positioning of trees is critical for correlating ground survey measurements with the corresponding aerial photography or satellite positions. The ground truth data is useful for calibrating and validating radar satellite imagery in biomass assessment surveys. GPS offers rapid methods of establishing both control and capturing field data. While Differential-GPS gives highly accurate ground positions, Electronic Distance Meter (EDM) surveying techniques are used to compliment GPS measurements when field conditions are not favourable. GPS accuracy is degraded when receivers are operated under dense tree canopies. Connecting field surveys to national mapping systems or GPS networks allows easy integration of woodland spatial information with data from other sectors. This is constrained by the lack of common reference frameworks. In Africa, a unified African Reference Framework (AFREF) is still in its formative stages and network GPS is not yet fully developed. South Africa is the probably the only country that has a well developed GPS infrastructure. Although commercial GPS base stations are available, the required initial capital investment and annual maintenance charges often limit their use in developing countries. This paper proposes a method which combines rapid static DGPS, EDM topographic surveying and mobile GIS techniques to capture, compute and record absolute positions and vegetation parameters of preferred fuelwood tree species in African savanna woodlands. The proposed method will generate ground-truth data for preferred fuelwood species in selected case study villages under the VW Foundation Biofuels Modeling project, covering Zambia, Mozambique and South Africa.