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Water use by Sclerocarya birrea Agroforestry Trees in Sudanian Savanna : Application of Wireless Sensor Networks

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Small scale rain fed agriculture is the primary livelihood for a large part of the population of Burkina Faso. Regional climate change means that this population is becoming increasingly vulnerable. Additionally, as natural savanna is converted for agriculture, hydrological systems are observed to become less stable as infiltration is decreased and rapid runoff is increased to the detriment of crop productivity, downstream populations and local water sources. The majority of the Singou River Basin, located in South East Burkina Faso is managed by hunting reserves, geared to maintaining high populations of wild game; however, residents surrounding the protected areas have been forced to intensify agriculture that has resulted in soil degradation as well as increases in the frequency and severity of flooding and droughts. Agroforestry, or planting trees in cultivated fields, has been proposed as a solution to help buffer these negative consequences, however the specific hydrologic behavior of the watershed land cover is unknown. Sclerocarya birrea, or Marula, is a dominant agroforestry tree in the region valued for its medicinal, ritual, and hydrologic services. We explore the effect of Sclerocarya birrea trees on the soil moisture response to precipitation in millet-dominated agricultural fields in the village of Tambarga, Burkina Faso. We compare the water budget constructed surrounding a single Sclerocarya birrea tree with that in an open field using measured values of soil water content, canopy infiltration, precipitation, evaporation.

Data are collected through a distributed sensor network of 17 Sensorscope wireless meteorological stations in addition to 2 eddy covariance stations and sap flow probes. These stations are dispersed across cultivated rice and millet fields, natural savanna, fallow fields, and around agroforestry fields. Three of the stations are uniquely configured around Sclerocarya birrea trees. Sensorscope routes data through the network of stations to be delivered by a GPRS connection to a main server. Data are available in real time via a website that can be accessed by a mobile phone. The stations are powered autonomously by small photovoltaic panels. This deployment is the first time that these meteorological stations have been used on the African continent. Results from this research are being coupled with outreach activities in the community in order to best integrate them into local practices. Our hope is that the results of our modeling will inform local farmers and thus help improve their adaption to changing weather patterns and land cover.