

## Abstract

Miombo woodlands are one of the most extensive vegetation types found in several southern and central African countries namely, Angola, Zimbabwe, Zambia, Malawi, Mozambique and Tanzania, as well as most of the southern part of the Democratic Republic of Congo; and are mostly dominated by tree species in the genera *Brachystegia*, *Julbernardia* and *Isoberlina*, with occurrence varying according to the different miombo determinants. The widespread use of wood fuels in Zimbabwe, and in developing countries in general, has been associated with several environmental problems, more specifically deforestation and forest degradation resulting in the decline of the growth and diversity of miombo woodland tree species. As such, this study was aimed at presenting the impacts of firewood extraction on miombo woodland in Zimbabwe and to propose possible forest landscape restoration scenarios, using Hwedza communal area as a case study. Both quantitative and qualitative approaches were applied. Two scenarios were explored, one in which there was no extraction of firewood from the forest, using Imire game park as a reference site, and the other scenario in which there was extraction of firewood, using the communal areas of Hwedza as the firewood harvesting sites. A literature review mainly focused on giving an overview of firewood consumption in Africa in general, Sub-Saharan Africa and more specifically in Zimbabwe was conducted. Remote sensing data for this study were obtained from Landsat as well as from Google Earth images. A regular grid of 30x30m with 49 sampling points each, was used to determine crown cover percentage in the firewood harvesting sites which was then used to carry out an inventory on miombo woodland structure in Hwedza. The percentage crown cover was classified as "low", "medium" and "high" for plots with crown cover <20%, crown cover > 20% to <50% and crown cover >50% respectively. Socio-economic data were collected through individual interviews. The Quantitative data were analysed using the Statistical Software RStudio. Data collected from interviews were analysed using textual analysis as well as using facts from field observation to interpret the data. The literature review conducted showed that there is insufficient data on the effects of firewood extraction in sub-Saharan Africa as well as on the Zimbabwean miombo. A total of 113 tree species, 90 sapling species and 78 seedling species were recorded in the firewood harvesting sites while 13 tree species, 24 sapling species and 21 seedling species were recorded in the reference sites. Although diversity measures (stem density, species richness, Shannon-Weiner diversity index and Simpson index) were significantly lower in reference sites, reference sites had a higher mean basal area (10.8m<sup>2</sup>/ha) and aboveground biomass (34.79 tC/ha) as compared to firewood harvesting sites (5.2m<sup>2</sup>/ha and 10.83tC/ha respectively). A Welch two-sample test performed confirmed the significant differences between the two sites ( $p < 0.05$ ). A total of 84 tree species, 54 sapling species and 55 seedling species were recorded in low crown cover plots, 75 tree species; 45 sapling species and 44 seedling species were recorded in medium crown cover plots; and 93 tree species, 51 sapling species and 54 seedling species were recorded in high crown cover plots. A Kruskal-Wallis- $H$  test showed no significant differences in species richness, stem density, basal area, above ground biomass and Shannon-Wiener Diversity as well as Simpson indices, across the different crown cover classes ( $p < 0.05$ ). The highest estimated aboveground biomass was in medium crown cover sites (mean=14.16 tC/ha) and the lowest was observed in low crown cover sites (mean= 7.42tC/ha). DBH size class distribution showed inverse J distribution patterns across the three crown cover sites and the basal area ranged from 0.46m<sup>2</sup>/ha, recorded in high crown cover plots to 26.22m<sup>2</sup>/ha recorded in medium crown cover sites. *Brachystegia spiciformis* and *Julbernardia globiflora* were the most preferred firewood species in Hwedza. The species that contributed most to basal area are: *Brachystegia glaucescens* (13.35%), *Brachystegia boehmii* (10.22%), *Julbernardia globiflora* (9.19%), *Brachystegia spiciformis* (5.23%), *Kirkia acuminata* (5.16%), *Colophospermum mopane* (4.3%), *Lannea discolor* (3.75%), *Combretum molle* (3.4%), *Parinari curatellifolia* (2.75%) and *Brachystegia manga* (2.67%). Because of harvesting pressure observed, exotic species could be planted nearest to the villages for provision of firewood whilst indigenous woodlands are passively restored in farther locations. Firewood harvesting was the most common disturbance observed and may be unsustainable, which becomes problematic since local households are entirely dependent on the woodland. Investigating effective forest landscape restoration approaches may help to resolve some of the social and ecological challenges in the area.

**Key words:** miombo, firewood, species diversity, aboveground biomass, regeneration status.