



# Developing an Operational Method for Assessing Forest Resources in *Abu Haraz* Reserved Forest in Kordofan, Sudan



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## Introduction:

Forest resources in Sudan play different roles in characterising the ecological and environmental changes as indirect benefit and satisfy a wide range of needs for the rural population (food, shelter, energy, income). The area under forest reserve is five million hectares, which is equivalent to 2.2% of the total area of the country. Forests in Sudan contribute to 82% of the total energy consumption in the country. In fact, the population is increasing while resources are limited, and the population exerts great pressure on the forest for fuel, wood, charcoal, grazing of animals and agriculture expansion. These resulted in the destruction of most reserved forests. Due to decline in forest resources in Sudan and the expected bad consequences, quantifying and appraising of the existing resources and their sustainable management is needed.

## Objective:

The aim of the research is to develop an operational method to assess the forest resources in *Abu Haraz* natural reserve forest in Kordofan using cluster sampling method.

*Abu Haraz forest*, which is selected as the study area, is the biggest natural reserved forest in Kordofan and located in low rainfall woodland savannah, and under the protection and administration of forest national corporation.

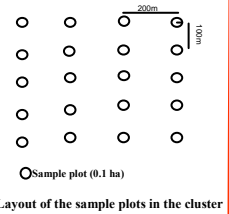
Republic of the Sudan



Location of the study area

## Material and methods:

- Six systematic cluster sampling were used and distributed in the forest with equal distances.
- Each cluster covers an area of 60 ha, and includes 25 circular sample plots
- Tree parameters (tree specie, diameter, height, crown diameter) were collected from trees with dbh  $\geq 7$  cm.



- Methods of data analysis includes: Volume computation, regression function (step-wise regressions) and intracluster correlation coefficient calculation.

Where:

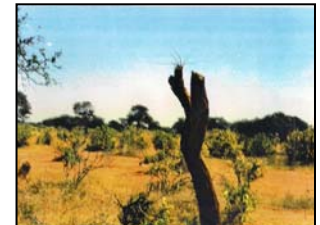
$\rho$  intracluster correlation coefficient  
 $S_b^2$  Variance between clusters  
 $S_w^2$  Variance within clusters  
 $S^2$  Total variance of clusters  
M Number of elements per cluster  
n Number of clusters sampled  
N Number of clusters in the population

$$S^2 = \frac{(n-1)S_b^2 + n(M-1)S_w^2}{nM-1}$$

$$\rho = \frac{S_b^2 - S^2}{(M-1)S^2}$$



grazing of animals in the forest during dry periods



Pollarding of trees for animal grazing in the forest

## Results:

- Results showed that the reserved forest is dominated by two species, *Albizza amara* and *Lannea humilis* with 34% and 46%, respectively. The rest of the forest is covered by other ten tree species.
- The density of the trees is found to be of 37 tree/ha, volume is 24.13 m<sup>3</sup>/ha and basal area is 2.25 m<sup>2</sup>/ha.
- 72% of the growing stock is found in diameter class between 27 – 31cm.
- The sampling error and intracluster correlation coefficient error were found to be  $\pm 10\%$  and 0.07, respectively.

Volume function of *Albizza amara*:

$$V = 0.111 + 17.05BA + H^2 + DBH \cdot H$$

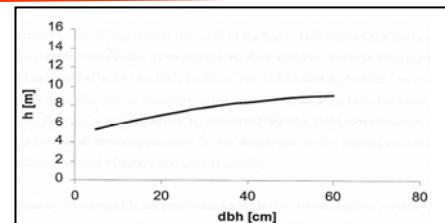
Volume function of *Lannea humilis*:

$$V = 0.136 + 17.95BA + H^2 - DBH \cdot H$$

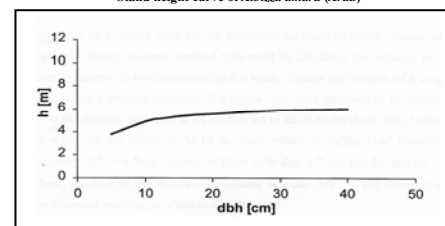
Where:

V Volume  
BA Basal area  
H Tree height  
DBH Diameter at breast height

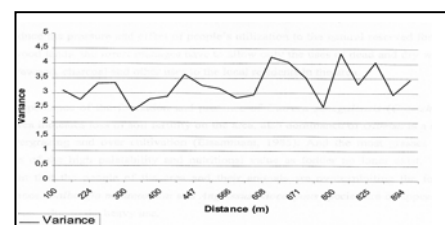
- Disturbances in the forest is limited to seasonal grazing, forest activities (fuelwood, charcoal making and local construction material) and agricultural activities.
- Natural regeneration was found extremely very low due to the grazing and accident fires.



Stand height curve of *Albizza amara* (Arad)



Stand height curve of *Lannea humilis* (Leyoun)



Variance versus plot spacing in meters

## Conclusion:

- Management plan for *Abu Haraz* reserved forest should be established to increase the productivity of the resources and to reduce the degradation of the forest.
- Use of recently innovated and developed charcoal burning stoves should be encouraged through production and distribution in the area.

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