1 INTRODUCTION

1.1 Background of the study

Humans have exploited forests for thousands of years as they seek to use forest species as resources for food, fuel and timber, or to clear forested land for agricultural and urban purposes (Young and Boyle, 2000; Ledig, 1992). On a global scale, world forests are declining at an alarming rate due to human population growth, which has doubled in the last 50 years (Geburek, 2005). From 1990 to 2005, the world lost 3% of its total forest area, an average decrease of some 0.2% per year (FAO 2007). Specifically, forests exposed to intensive human disturbance are the species-rich tropical forest ecosystems (Young and Boyle, 2000). Between 1980 and 1990, 8.4% of the closed forest on the African continent underwent some form of land use conversion (FAO, 1993), while in the Brazilian Amazon, between 1978 and 1988, the annual rate of deforestation and fragmentation has been estimated at 53000 km^2 per year (Skole and Tuker 1993). In particular, a more recent report classified Nigeria to be among the countries that has the highest rate of deforestation in the world (FAO, 2005). Between 2000 and 2005, 55.7% of Primary Forests in Nigeria were lost due to human activities such as logging, subsistence agriculture and collection of fuelwood. The consequence of such impact has been desertification, loss of valuable tree species, loss of habitat for wildlife animals (Collins, 2001), fragmented forests and small pieces of forests embedded in a largely agricultural matrix (James *et. al.* 1998). From a genetic point of view, it is likely that the remnant forests will lack formerly existing genetic variants due to genetic drift (Finkeldey and Hattemer 2007).

Genetic diversity possessed by a species is crucial for its long term survival (Booy *et. al.*, 2000), and this has made conservation of genetic diversity in species to be of high priority. The traditional view that human practices in the forest will lead to genetic erosion in tree species create the notion that human's interference in the forest does not favour conservation of genetic diversity, and that lack of human intervention will ensure a status quo in forest ecosystems. This notion has been reported not to help maintain or enhance genetic diversity (Eriksson *et.al.* 1993;

Palmberg-Lerche, 1990; Palmberg-Lerche, 2002). Human activities are not necessarily negative to forest ecosystems if forest management is properly carried out (Palmberg-Lerche, 2002; Wang 2003). For instance, in contrast to non-pioneer tree species, regeneration of pioneer tree species can be enhanced by human disturbance (Bazzaz, 1991), meaning that pioneer species are expected to be more abundant in disturbed open forests where environmental conditions favour their regeneration. Since human disturbances tend to have opposite impacts on the regeneration potential of non-pioneer and pioneer species, also different effects on genetic diversity levels are expected. Hence, proving this expectation in tropical trees will be of interest to forest conservationists in the tropics because it will provide information that is essential to the management of genetic diversity in tropical trees.

Ledig (1992) acknowledged that impact of deforestation and exploitation on genetic diversity in forest tree species is difficult to document because baseline data are not available. This is due to the fact that other land uses have replaced original forests, and the extent of the genetic diversity in the original forests is not known. A direct approach in assessing the impact of human-induced disturbance on genetic diversity in trees will then be to compare disturbed forests with the original forests that exist in the same environment. In such case, the original forests serve as reference on which the extent of human impacts is measured. In this study, this approach was employed in analysing the effect of human impact on the genetic diversity in *Mansonia altissima* and *Triplochiton scleroxylon.* Since the whole study area was previously a continuous forest, it was assumed that the sampled populations possessed comparable level of genetic variation prior to their fragmentation, although there is no empirical data to verify this.

Natural distribution of *M. altissima* and *T. scleroxylon* span dry areas of lowland rainforest of West Africa and Central Africa, covering countries like Sierra Leone, Ivory Coast, Ghana, Benin, Nigeria, Cameroun and Congo (only *T. scleroxylon*). The two species belong to the same family Sterculiaceae and are both important timber species (Hawthorne, 1995). Up to date, this is the first study on providing information on the effects of human impact on genetic diversity in *M. altissima* and *T. scleroxylon*. Since there is no prior sequence information on *M. altissima* and *T. scleroxylon*, amplified fragment length polymorphism (AFLP) markers were used in the analyses. The advantages of the AFLP technique rest on the high reproducibility of the generated fingerprint patterns and the high number of markers that can be produced without prior sequence information (Coart *et. al*., 2005).

1.2 Objectives of the study

The objectives of this study were:

1. To analyse the genetic consequences of human impacts on genetic diversity in *M. altissima* in Akure Forest Reserve, Nigeria.
2. To assess the effect of human impacts on the genetic diversity in *T. scleroxylon* in Akure Forest Reserve, Nigeria.
3. To compare the genetic diversity of *M. altissima* and *T. scleroxylon* under the prevailing human impacts in Akure Forest Reserve, Nigeria.

1.3 Hypotheses

Following hypotheses were tested in this study:

1. Human impact reduces genetic diversity in the investigated tree species.
2. Human impact results in strong spatial genetic structure in the investigated tree species.
3. *Triplochiton scleroxylon* possesses higher genetic diversity than *Mansonia altissima.*
4. Human impact have an opposite effect on the genetic diversity in the investigated tree species.

1.4 The Study Area

The study was carried out in Akure Forest Reserve in south-western Nigeria (Figure 1.1). The prevailing climate in the Forest Reserve is humid tropical (Ola-Adams and Hall, 1987) and is classified into two seasons; dry and wet. November to February constitutes the dry season in which precipitation is low, while March to October classified as the wet season have the characteristic of high precipitation. The mean annual rainfall is about 1500 mm while the average temperature is about 25 ^{0}C. Details of rainfall and temperature data of the Forest Reserve are shown in Figure 1.2 and 1.3, respectively. The Forest Reserve is well drained due to the presence of the Owena River, which flows north to south across the Forest Reserve into the Atlantic Ocean about 160 km away. According to the geological description of the forest reserve given by Ola-Adams and Hall (1987), the underlying rock of the Forest Reserve is crystalline, mainly gneissose and referable to the basement complex. As a result of continuous weathering, the ferric luvisol soils which feature abundantly in the typical upland soils in many parts of southwestern Nigeria are also present in Akure Forest Reserve (FAO/UNESCO, 1988).

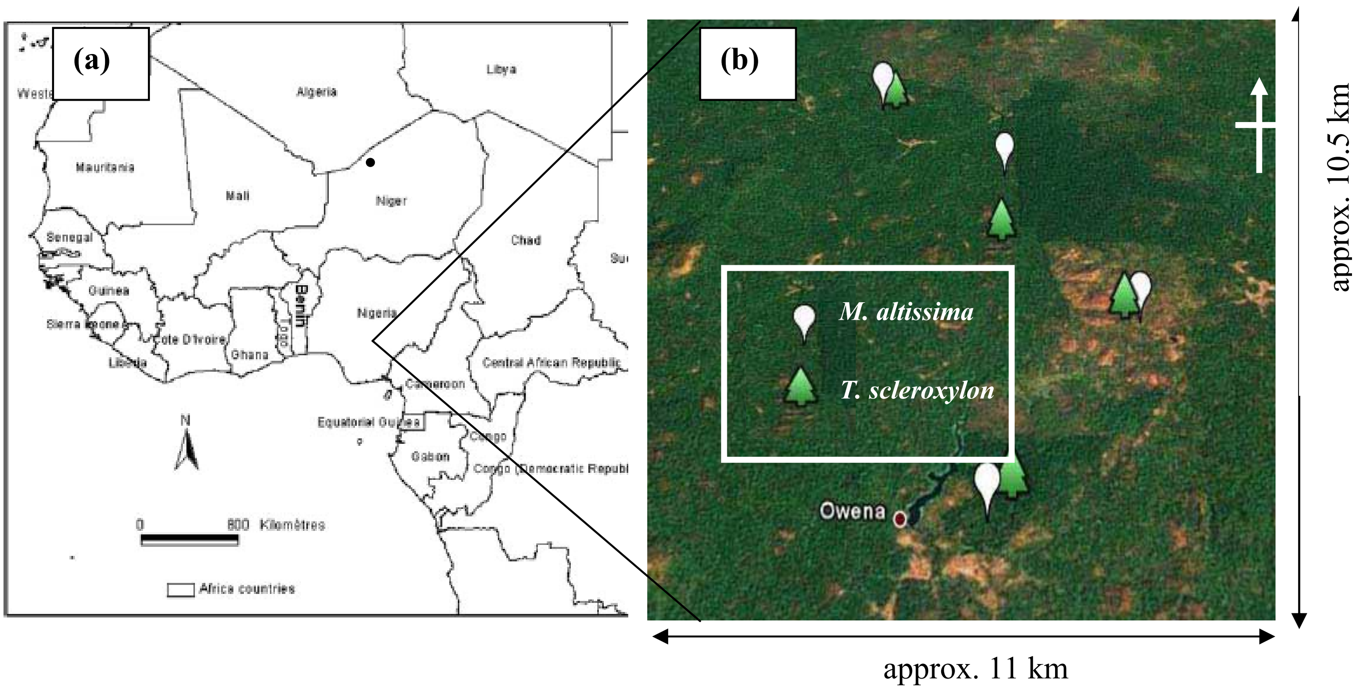

Figure 1.1: Study area (a) Location of Akure Forest Reserve in Nigeria, (b) Satellite image showing locations of study plots in Akure Forest Reserve

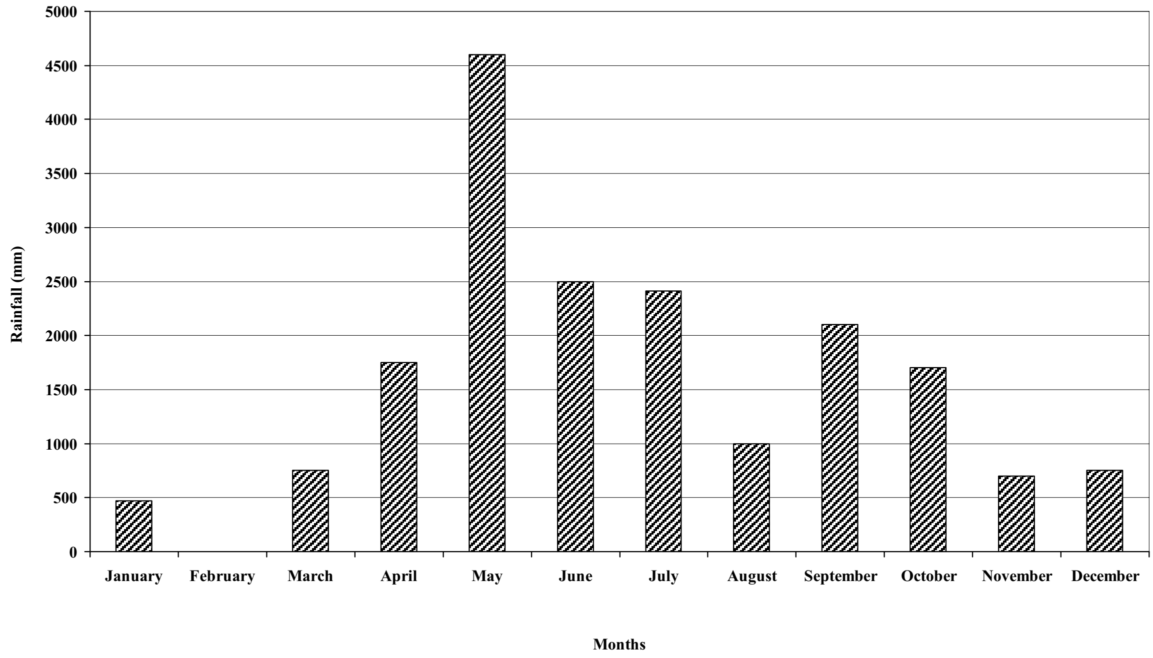

Figure 1.2: Mean monthly rainfall data in Akure Forest Reserve, Nigeria (Somade, 2000)

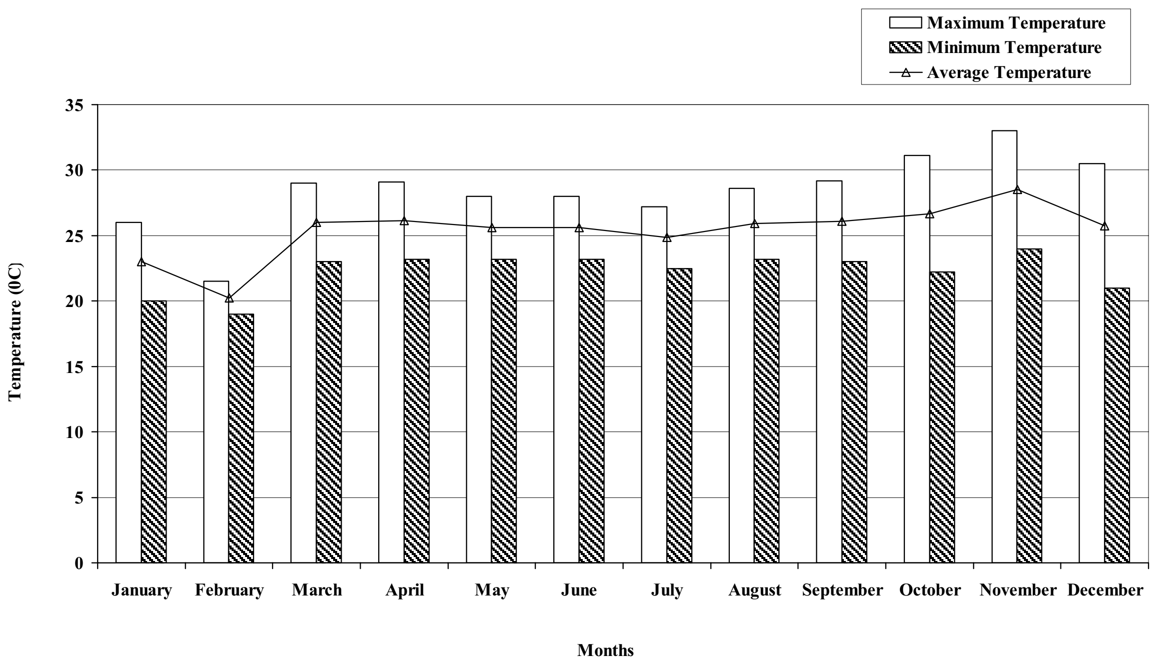

Figure 1.3: Mean monthly temperature data of Akure Forest Reserve, Nigeria (Somade, 2000)

The natural vegetation of the Forest Reserve was categorised by Jones (1948) into four storeys of woody plants namely; emergents (above 40 m), upper storey (20 – 40 m), lower storey (3 – 20

m) and shrubs. 79 different tree species were identified in a 2-ha monumental plot within the Forest Reserve, in which *Celtis ssp, Mansonia altissima* A. Chev., *Triplochiton scleroxylon* K. Schum, *Cola gigantea* and *Drypetes gilgiana* are among the dominant species. (Akinnagbe, 2002).

1.4.1 Human Activities in the Study Area

Akure Forest Reserve was previously a continuous forest but has now been fragmented due to human activities. Scattered stands of *Elaeis guineensis* (Palmaceae) in the Forest Reserve give indication that it has a long history of human activities such as farming (Sowunmi, 1981; Figure 1.4). Additionally, there have been logging (Figure 1.5) and plantations of both indigenous and exotic tree species in the Forest Reserve. In most cases, the plantations have been in form of Taungya farming (Figure 1.6). In the Forest Reserve, there are also settlements and villages (Figure 1.7) which serve as dwelling place for farmers within the Forest Reserve. In the early 1930's, the Federal Department of Forest Research (now Forestry Research Institute of Nigeria) demarcated an experimental Permanent Sample Plot (PSP) number 29 (see Figure 1.8) in Akure Forest Reserve. This plot which is structurally and floristically illustrative of Akure Forest Reserve (Jones 1948; Ola-Adams and Hall, 1987; Akinnagbe and Akindele 2003) serves as baseline plot for this study.