LITTER PRODUCTION AND NUTRIENT INPUT IN *BAMBUSA VULGARIS* SCHRAD.EX J.C. WENDL. STANDS IN A SECONDARY RAINFOREST AT THE OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA.

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CERTIFICATION

This is to certify that this research study was carried out by Tolulope Victor BORISADE as part of the requirements for the award of Master of Science degree in Botany of the Obafemi Awolowo University, Ile – Ife.

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DEDICATION

To **JEHOVAH**, the GOD ALMIGHTY, LATE mummy, Mrs Iyabo Borisade, my wonderful parent and siblings.

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ABSTRACT

The pattern of litter fall production, litter standing crop at the peak of rainy and dry seasons, nutrients contents in the litters, and the soil properties in the *Bambusa vulgaris* stands located within the secondary rainforest were assessed. This was with a view to providing information on nutrient cycling pattern in the bamboo stands.

Two plots (25 m x 25 m) in *Bambusa vulgaris* stands and another two in the secondary forest where bamboos are not located were established. Litter fall production was determined monthly from June 2014 - May 2015 using litter traps of 1 m × 1 m × 30 cm, the collections of litter fall materials were done. Litter standing crop was also randomly collected at five points using quadrats of 50 cm × 50 cm in each plot at the peak of dry and rainy season. The collected litters were sorted into leaves and twigs, oven-dried at 70°C to a constant weight and weighed. The oven-dried samples were ground and analyzed for C, N, P, K, Na, Ca, Mg, Fe, Mn, Cu and Zn; lignin and cellulose. Soil samples were randomly collected at five points within each plot at a depth of 0-15 cm, air-dried, sieved and analyzed for pH, particle-size distribution, organic carbon, organic matter, total nitrogen, available P, exchangeable cations (Ca^{2+}, K+, Mg^{2+} and Na^{+}), other cations : Fe, Mn, Zn and Cu using standard methods.

The results showed that annual litter fall production (t ha^{-1} yr^{-1}) was 13.35 (total), 9.87 (73.9%) (leaf); 3.48 (26.1%) (twig). The litter standing crop (t ha^{-1}) at the peak of dry season was 2.38 (total), 1.59 (leaf), 0.79 (twig), and 2.01 (total), 1.17 (leaf), 0.84 (twig) at the peak of the rainy season. Leaf litter had highest concentration of Ca, K, Na, P, Mn, Zn and Cu, while C, Mg, Fe and N were highest in twig litter fall fraction. The annual depositions (Kg $ha^{-1}yr^{-1}$) of the nutrients in the litter fall are: C (4529.5), Ca (213.2), N (186.9), Mg (94.3), K (56.2), Fe (0.90), P

(0.40), Mn (0.07), Zn (0.03), Cu (0.009) and Na (0.001). The nutrients concentrations were higher at the peak of dry season than that of the rainy season; leaf litter had the highest nutrients concentration in the litter fall and in litter standing crop. The following soil properties: Exchangeable cations, pH, sandy content, organic C were significantly ($P < 0.05$) lower in soil of the bamboo stands, while total N, available phosphorus, silt and clayey content were higher in the bamboo stands.

The study concluded that the litter fall production pattern, litter standing crop, nutrients concentration and depositions showed seasonal variations with the leaf component having the highest production. Bamboo was also shown to be better conservers of C, N and P if properly managed as a nutrient recycler to the ecosystem.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Forest and Forest Products

The importance of forest to man and our environment cannot be over emphasized.However, the widespread deforestation and degradation of natural habitats have continued unabated and thishas contributed heavily to the loss of species (Primm*et al.,* 1995).With past and continued destruction of primary forests worldwide, there is increasing interest in secondary forests, their role, structure, and function (Lugo, 1997; Smith *et al.,* 1998; Emrich *et al.,*2000). Secondary forests now constitute large areas in many countries (Spurr and Barnes, 1980; Brown and Lugo, 1990), and are becoming an increasing component of forest cover in many tropical countries as regrowth following deforestation (Brown and Lugo, 1990; Dubois, 1990; Chazdon and Denslow, 1996;Emrich *et al.,*2000;De Jong *et al.,*2001).This large and growing renewable resource can provide a wide range of valuable goods and services important at the local, national, and international levels (Unnaand De Jong, 2001).

Forests World-wide are being continuously disturbed thereby destroying the communities inhabiting them and sending them back in the course of successions, the new series of community tending again towards climax (Odiwe and Muoghalu, 2003). Proper use of forests for economic growth is a viable option in developing countries for conservation of forests—the ‘‘use it or lose it’’ principle (Seydack, 2000). Previously, forests were mainly assessed in terms of the commercial value of timber. Rarely was other forest components considered to be of major economic importance (Kigomo, 2007). In the 20th century, when vast areas of tropical forests were denuded of timber for local use and exportation, bamboos, and other non-wood products were usually discarded or destroyed during logging operations(Kigomo, 2007). In the 21st century, however, there is a growing consensus that non-wood forest products are not only crucial to ecosystems, but also valuable to the livelihood of communities (Kigomo, 2007).

Non-wood forest products are known to generate substantial foreign exchange and are increasingly being regarded as valuable commodities around the world. Theperception and evaluation of non-wood forest products is changing due to alarming rates of deforestation and decreased timber yields (Kigomo, 2007). With the increasing demand for a return to nature, there is an increasing preference for products processed or extracted from plants. With its high growth rate, wide range of applications and high renewing ability, bamboo resources occupy a significant position in the 21st century (Salam, 2008). Unfortunately, most bamboo is harvested from forest stands at a rate which exceeds natural growth which makes current utilization unsustainable (IFAR/INBAR, 1991; Tewari, 1992). More than half of this amount is harvested and utilized by the poor in rural areas (Scurlock *et al.*,2000). In a rapidly changing world, however, households develop a myriad of livelihood options and in several cases bamboos are considered to be an important livelihood strategy of rural people.

Bamboo is not only an ideal economic investment that can be utilized in many different manners but also has enormous potentials for alleviating many problems, both environmental and social, facing the World today (Zhou *et al*., 2005). The increasing rate of tropical deforestation makes the search for alternative natural resources important (Zhou *et al*., 2005). The characteristics of bamboo make it a perfect solution for the environmental and social consequences of tropical deforestation (Zhou *et al*., 2005). Its biological characteristics make it a perfect tool for solving many environmental problems, such as erosion control (Austin *et al.*, 1970) and carbon sequestration (Zhou *et al.*, 2005).

Coincidentally, bamboo is being elevated from a raw material known as the "*poor man's timber*", to the status of the "*timber of the 21st century*" (http://agricoop.nic.in/ bamboo/bamboomission.htm).Many countries have been forced to severely restrict, and in some cases, even ban outright the harvesting and exportation of bamboos (Kumar *et al.*, 2005). For many developing countries, this translates into the loss of potentially great economic opportunities. The greatest losses though, are borne by the poor, especially the rural poor, as a once abundant and cheap material that provided sustenance, shelter, and income has become scarce and expensive (Kumar *et al.,* 2005). Various studies have shown that a sustainable utilization of bamboo resources has a big impact on the development of any community (Kwiyamba, 2005).

1.2 Role of Bamboo in the 21st Century

Bamboo is a perennial, giant, woody grass belonging to group of Angiosperm (Chapman, 1996) and the order; Poales (Abd.latif *et al.*, 1990). The grass family Poaceae can be divided into one subfamily Centothecoideae and five large subfamilies, Arundinoideae, Pooideae, Chloridodeae, Panicoideae and Bambusoideae. In distinction to its name, Bamboos are classified under the subfamily Bambusoideae (Chapman, 1996). Wang and Shen (1987), stated that there are about 60-70 genera and over 1,200- 1,500 species of bamboo in the world. About half of these species grow in Asia, most of them within the Indo-Burmese region, which is also considered to be their area of origin (Grosser and Liese, 1971). Some examples of Bamboo genera are *Bambusa*, *Chusquea*, *Dendrocalamus*, *Phyllostachys*, *Gigantochloa* and *Schizostachyum*. Most of the bamboos need a warm climate, abundant moisture, and productive soil, though some do grow in reasonably cold weather (-20°C) (Wang and Shen, 1987).