The Distribution, Density, and Estimates of Carbon and Inorganic Nutrients in some Lesser-Used Species

Dr. Dominic Blay, FORIG, Ghana

Introduction

Timber is the third foreign exchange earner for Ghana and timber exports had for some time now been based on the so-called prime timber species (Table 1) with little attention being paid to other species called secondary species or Lesser-Used species (LUS). This is with the result that prime species have been exploited, most of them are currently threatened, and their harvesting either reduced or banned.

To sustain the timber industry therefore attention has been focused on the promotion of the Lesser-Used species.

Currently however, many international initiatives have focused on sustainable management of forests, and this has resulted in the establishment of Forest Stewardship Council (FSC) which has the ambition of setting world-wide standards for good forest management (FSC, 1992). The FSC is currently drawing up the principles and criteria for forest management which they hope will be used by organisations for forest monitoring and certification, consumers of forest products and policy makers. The FSC is also proposing to become an independent non-governmental international organisation, which will evaluate, accredit and monitor forest certification programmes. Certification of forest products will be one way to promote sustainable forest management practices. They propose that this should be market driven. Certification initiative that will provide economic rewards to forestry operations which will ascribe to management practices that are ecologically sustainable, socially beneficial and economically viable. By complying with certifying standards, the forest products will be granted access to the burgeoning worldwide 'green' market. The implications are that unless forestry activities are sustainable and environmentally acceptable, access to market will be difficult. Thus, sustainable forest management is necessary if the marketing of LUS is to succeed.

Sustainable forestry as recently defined means "the stewardship and use of forests and forest land in such a way and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil now and in the future, relevant ecological, economic and social functions at local, national and global levels, and that does not cause damage to other ecosystems" (Helsinki Ministerial Conference, 1994).

Maintenance of productivity is an essential factor for sustainable forest management. However, one of the most important factors for productivity is nutrient availability. Thus in assessing the ecological sustainability of forest activities, the impact on nutrient availability should be determined. Many studies have however shown that in tropical forests between 60-90% of nutrients are stored in the above-ground biomass (Jordan 1985, Ruhiyat 1989). Thus, estimation of nutrients in the above-ground biomass of any species is a good indicator of the contribution of the species to nutrient availability in the ecosystem. Also among current global environmental problem that is of most concern is the accumulation of green house gases in the atmosphere which has begun to change the global climate (IPCC 1990).

Reports suggest that managed forests and agroforestry systems have the potential to sequester and conserve about 10GT of carbon annually. Thus one of ecologically functions of the forest that is of global interest and which should be part of sustainable forest management practices is the sequestration and conservation of carbon.

However, the contribution of LUS in Ghana to nutrient availability and sequestration of carbon is not known. However, these contributions to ecological sustainability cannot be discussed without reference to the resource base. This paper therefore provides estimates nutrient and carbon storage of some Lesser-Used species as well as distribution and density.

Distribution and density

The LUS considered in this paper are shown in Table 1. Concerning distribution, *Ceiba pentandra* and *Antiaris toxicaria* were the two species that had the widest distribution with distribution in all the forest ecological zones. *Celtis mildbraedii* and *Sterculia rhinopetala* were distributed in all the forest ecological zones except the Wet Evergreen Forest Zone.

Petersianthus macrocarpus and *Cylicodiscus gabunensis* were however restricted mainly to the Moist Evergreen and Moist Semi-Deciduous Zone.

Table 1: Some Lesser-Used species with the total volume and above felling limit

Timber	Local	Species	Stocking above felling limit (CU.M)
Ceiba	Onyina	*Ceiba pentandra*	3,240
Albizia	Awiemfosamina	*Albizia ferruginea*	5,371
Antiaris	Kyenkyen	*Antiaris toxicaria*	10,134
	Bonsamdua	*Distemonanthus benthamianus*	3,885
Yellow Sterculia	Wawabima	*Sterculia rhinopetala*	5,308
	Esia	*Petersianthus macrocarpa*	23,665
Celtis	Esa	*Celtis mildbraedii*	67,709
	Denyau	*Cylicodiscus gabunensis*	16,209

This distribution might be related to the soil fertility, pH and rainfall in the different ecological zones. Thus *Ceiba* and *Antiaris* are widely distributed because they can tolerate the acidic soils as well as nutrient rich and poor soils.

Celtis mildbraedii and *Sterculia rhinopetala* on the other hand may be sensitive to low pH and nutrient soils, while *Petersianthus macrocarpa* and *Cycliodiscus gabunensis* had the highest total stocking i.e. for all species >5cm dbh as well as the highest stocking for trees above the felling limit. *Sterculia rhinopetala* had the next highest total stocking, but had the lowest stocking above felling limit.

Petersianthus macrocarpa had the next highest total stocking. However, the stocking above felling limit was almost equal to that of *Ceiba pentandra*, which also had almost equal total stocking to that of *Antiaris toxicaria*.

Ceiba pentandra however had almost twice stocking above felling limit as *Antiaris toxicaria*.

Cyclicodiscus gabunensis had the lowest total stocking but the stocking limit was higher than that of *Sterculia rhinopetala*.

Carbon and nutrient content

The carbon and nutrient content for the LUS in the Moist Evergreen and Moist semi-Deciduous Forest Ecological Zones are shown in Tables 2 and 3.

In the Moist Evergreen Zone, *Celtis mildbraedii* had the highest content and this was closely followed by *Cylicodiscus gabunensis*. The carbon content for the other species in decreasing order *Distemonanthus benthamianus> Ceiba pentandra >Albizzia ferruginea> Petersianthus macrocarpa> Antiaris africana*.

In the Moist Semi-deciduous zone, the carbon content in decreasing order were *Cylcodisus gabunensis> Albizzia ferruginea> Petersianthus macrocarpa> Ceiba pentandra> Celtis mildbraedii >Antiaris toxicaria> Distemonanthus benthamicumus*.

This same pattern was observed for the accumulation of nutrients. Comparing the two ecological zones, it could be observed that species in the moist semi-deciduous zone had higher accumulation than the species in the moist evergreen zone. The differences observed could be attributed to the soil pH and nutrients in the different zones (Schulte 1994). The moist semi-deciduous zone which has soils of slightly lower pH and higher cation capacity than the soils of moist evergreen zone had the higher accumulation of carbon due to the higher growth rate and hence higher biomass. However, the differences observed for the different species in the same ecological zone could be attributed to the inherent characteristics of the species which differ from one species to another (Whitmore 1975).

Conclusion

Lesser-Used species contribute significantly to the productivity of the forest ecosystems through storage of nutrients that are subsequently re-cycled through litter fall and decomposition. They also fix a lot of carbon dioxide into timber that is expected to prevent global warning. Since decreased productivity and global warning will have negative effects on many forest ecosystems, these ecological functions of the LUS are wise investments for sustainable forest management. However, the amount of carbon and nutrients stored differ between species on the same site and also differ for the same species under different site contributions.

Thus in allocation Lesser-Used species as yield for felling consideration should seriously be given to these ecological functions they perform.

Table 2: Amount of carbon and other nutrients (kg/ha) in whole tree of some Lesser-Used species (LUS) in Moist Evergreen Forest Zone

Species	Biomass	C*	N	P	K	Ca	Mg
Albizzia ferruginea	10.3	5173	236	5	51	206	26
Antiaris toxicaria	7.8	3939	181	4	39	157	19
Ceiba pentandra	11.6	5811	267	6	58	232	29
Celtis mildbraedii	21.8	10900	501	11	109	436	55
Cyclicodiscus gabunensis	20.1	10190	409	10	101	407	51
Distemonanthus benthamiamus	12.3	6168	283	6	61	246	31
Petersianthus macrocarpa	8.1	3939	186	4	41	163	20

**The C content was estimated from C = stem volume x 1.6 x Density x 0.5*

Table 3: Amount of carbon and other nutrients (kg/ha) in whole tree of some Lesser-Used species (LUS) in Moist Deciduous Forest Zone.

Species	Biomass	*C	N	P	K	Ca	Mg
Albizzia ferruginea	14.1	7060	324	7	71	282	35
Antiaris toxicaria	8.7	4354	200	4	43	174	22
Ceiba pentandra	11.7	5862	269	6	59	232	29
Celtis mildbraedii	11.5	5795	116	6	58	232	29
Cyclicodiscus gabunensis	23.1	11550	531	12	115	462	58
Distemonanthus benthamiamus	6.3	3168	145	3	32	126	16
Petersianthus macrocarpa	12.8	6400	294	6	64	256	32

The C content was estimated from C = stem volume x 1.6 x Density x 0.5

References

Forest Stewardship Council 1992. The Principles and Criteria for Forest Management: A Discussion Paper. Forest Steward Council. Box 188, Richmond, Vermont, USA.

Jordan, C. F. 1985. Nutrient Cycling in Tropical Forest Ecosystems. John Wiley and Sons. N.Y.

Olbrich K., Christie, S.I., Evans, J,. Everard, D., Olbrich, B. & Scholes, R.J. 1997. Factors Influencing the Longterm Sustainability of the South African Industry. *Southern Africa Forestry Journal*. 178: 53-58.

Dixon, R.K., Schroeder, P.E & Winjum, J.J. 1991. Assessment of Promising Forest Management praCtices and Technologies for Enhancing the Conservation and Sequestration of Atmospheric Carbon and their Costs at the Site level. USEPA. Corvallis.

Ruhiyat, D.1989. Die Entwicklung der standorlichen Nahrstoffvorrate bei naturnaher. Waldberwirtschaftung und in Plantangen betriels; Ostkilimatan, Indonesia. Gottinger. Beitrage zur land-und Forstwirtschaft in den Tropen und subtropen 35.

Helsinki Ministerial Conference 1994. Protection of Forests in Europe, Liaison Unit in Helsinki. European Criteria and Indicators for Sustainable Management.