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FUELWOOD AND BIOMASS YIELD TABLES

FOR

LEUCAENA LEUCOCEPHALA

CASSIA SIAMEA

AZADIRACHTA INDICA

COLUBRINA ARBORESCENS

EUCALYPTUS CAMADULENSIS

PROSOPIS JULIFLORA

BY

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Yield Tables for *Leucaena leucocephala, Cassia siamea, Azadirachta indica, Colubrina arborescens, Eucalyptus camaldulensis* and *Prosopis juliflora* in Haiti

Introduction

This report presents the result of five months of silvicultural research designed to study the fuelwood, biomass and polewood production potential of six tree species. The trees studied include four exotic species and two trees indigenous to Haiti. *Leucaena leucocephala, Cassia siamea, Azadirachta indica* (Neem) and *Eucalyptus camaldulensis* comprise the exotic trees, while the indigenous trees are represented by *Colubrina arborescens* (Bois Kapab) and *Prosopis juliflora* (Bayahonde).

Each tree species was studied on one or more sites, reflecting some of the environmental conditions within which the species are commonly be found on the Haitian countryside. The study of each species involved the cutting of a sample of trees of different diameters, the weighing of the entire tree by sections and the sampling of the tree sections for laboratory analysis and determination of moisture content and specific gravity.

This report presents the results of the analysis of the fuelwood, polewood and biomass production potential of each species individually. Each species report is comprised of a descriptive section detailing the major findings of the research and describing the research site and methodology. The findings on fuelwood, biomass and polewood production are presented in the form of yield tables and in graphic form. Each yield table is designed to allow estimation of yields as a function of either DBH (at 1.3 meters) or stump diameter (at 10 cm). The tables enable computation of the production potential of any stand of trees of the indicated species, by simply counting the trees of each diameter class. One simple field measure, even approximate, could provide a reliable estimate of a stand's (or of a sample plot) production potential in terms of fuelwood (kg dry weight), total biomass (kg dry weight) and polewood (m^3/1000).

All the tables were produced using regression models that maximized the determination coefficient (r^2). Biomass yield and pole volume tables used the same regression equation for all species studied. Fuelwood tables were calculated using two different parameters: DBH and stump diameter. Two regression models were used for fuelwood production as a function of DBH and three models for fuelwood yields as a function of stump diameter.

One section of this report is dedicated to a comparative analysis of the tree species studied, not to determine the "most productive" tree, but to grasp in a general sense, each species' productive potential relative to other trees. These results present the findings in graphic form for a simple and clear interpretation of research findings.

Finally, in the recommendations section of this report, a number of general and specific suggestions are made relative to the research methodology, the need for future research and the implications of the results of this study on agroforestry activities in Haiti.

Fuelwood Production

A comparative analysis of fuelwood production for the six tree species studied shows that *Leucaena* is by far the better producer of fuelwood, at least in the earlier stages of growth. It should be mentioned that the site characteristics for this species, were very favorable for tree growth. Thus, independent of site characteristics, *Leucaena* produced more fuelwood than (in descending order) *Cassia, Prosopis* (Bayahonde), *Azadirachta* (Neem), ***Colubrina*** (Kapab) and *Eucalyptus*. Figure 1-G presents these findings in graphic form, while Table 1-G presents the results of this analysis in tabular form.

Specifically, *Leucaena* yields about 60 kg of dry fuelwood with a DBH of 12 cm, while an *Eucalyptus* tree of the same diameter yields only 27 kg. This could be partly due to the fact that, while *Eucalyptus* grows primarily along one axis (straight stem), *Leucaena* branches out considerably and has a voluminous crown from which fuelwood can be produced. This consideration is supported by the fact that, while the estimates of pole volume in the case of *Eucalyptus* correlate significantly with DBH, in the case of *Leucaena*, the same correlation is much less significant. A pole volume table for *Leucaena* was not produced due to the far greater variability of this tree species and the unreliability of the resulting prediction equation.

Table 2-G shows polewood production potential for *Cassia, Azadirachta* (Neem) and *Eucalyptus*. Figure 2-G presents the finding of this comparative analysis in graphic form. The results of the analysis suggest that *Cassia* produces the greatest polewood volume when compared to *Eucalyptus* and *Neem*. Specifically, while a 12 cm tree (at DBH) of Neem yields 3.3 cubic decimeters (dm^3) of polewood, *Eucalyptus* yields 4.2 dm^3 and *Cassia* 4.9 dm^3. In this case too, site conditions are assumed similar and to have no differential effect on tree growth for the three species studied.

It should be noted that this comparative analysis provides initial baseline estimates of fuelwood and polewood production.

Although data and regression equations for the six species studied are extremely good (r^2 values of 0.86 or better), verification of the accuracy of the yield tables across a wide range of different site conditions is necessary before an actual ranking of productive potential can be established with confidence.

Conclusions and Recommendations

The yield tables presented in this report, estimate production of fuel and polewood of six different tree species on one or more sites, whose conditions could significantly affect the trees' actual productive potential. The tables' accuracy needs therefore, to be cross-checked on different sites in order to account for the variability of site conditions within which these trees actually grow in Haiti.

Leucaena leucocephala in particular, requires additional sampling in order to account not only for site variability, but also for the variance encountered for this species in many of the growth parameters studied (i.e.,fuelwood weight, polewood volume, height, stem form, etc.).

Similarly, *Eucalyptus camaldulensis* has displayed unusual variability in moisture content and specific gravity, thus justifying additional sampling and laboratory testing.

The yield tables represent a significant first step in assessing the tree species' productive potential in terms of both fuelwood and polewood within the Haitian ecological context. Their practical value in terms of predicting specific yields on similar site conditions, could prove extremely useful in the planning and design of agroforestry applications across the Haitian countryside.

The yield tables for *Leucaena, Neem, Cassia, Eucalyptus* and *Prosopis* add scientific insight in tree species known abroad, but never studied in Haiti. The production tables for *Colubrina arborescens* (Kapab) contribute new knowledge relative to a tree species unknown outside of Haiti, yet very valuable for agroforestry application in most humid tropical areas.

In this regard, it is recommended that similar research be carried out for the study of other native trees of Hispaniola, whose potential in the field of agroforestry appears significant. Specifically, *Catalpa longissima* (Chene), *Simaruba glauca* (Frene) and *Swietenia mahoganii* (Acajou) should be studied for both fuelwood and polewood production potential. In addition, *Casuarina equisetifolia* an exotic tree whose agroforestry applications appear promising, should also be studied for its potential for producing fuel and poles in dry areas of the country.

Finally, the results of this research contribute significantly to the general body of knowledge about tree species used in agroforestry applications across the Central American and Caribbean region. The Center for Research on Tropical Agriculture (CATIE) in Costa Rica has shown interest in both the exchange of scientific data as well as in publication of research findings from the study reported here.

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Fuelwood and Biomass Production of *Leucaena leucocephala* at Camp Perrin (Haiti)

The Agroforestry Outreach Project relies to a large extent upon fast growing tree species for fuelwood production. *Leucaena leucocephala* (Lam.)de Wit., has been used since the start of the tree planting effort in 1982 and has definitively proven its worth as a rustic, fast growing and well received tree species. This species appears well adjusted to the variable ecological conditions of the Haitian countryside and only in a few extreme cases, native tree species such as *Prosopis juliflora*, appear better adapted. It is bound to be one of the main tree species used for reforestation in Haiti.

This report analyzes the fuelwood production potential of *Leucaena leucocephala* (K-8) on a hillside plantation near Camp Perrin, north of Les Cayes in the southern peninsula of Haiti. The plantation was established in 1980 on a hillside (57% slope) previously utilized for farming and grazing. Plantation density is approximately 800 trees/ha with spacing ranging from 2.5 meters to 4.5 meters. On the lower part of the plantation where the hillside meets the plain, the growth of trees is clearly better than on the higher part of the plot. Soil there, is in general shallower and more weathered; trees have both lower height and smaller DBH. Average annual precipitation in this area ranges from 1800 to 2320 mm. The area is included in the humid sub-tropical forest of the Holdridge (1963) classification and is located at 150 masl. The soil is 10 to 15 cm deep under the tree canopy, dark brown, clayish with little humus formation and a pH ranging between 8 and 9, on limestone parent material. This site is included in the Buffum/Campbell zone 31 (Buffum, 1984).

Method

A sample of trees from this plantation was cut at 10 cm from the ground to determine fuelwood and biomass production potential. The data collection and sampling techniques followed the methodology developed by the Fuelwood Project in Central America (CATIE, 1984). Three or more trees in each diameter class were cut, measured and weighed in sections. A total of 23 trees were cut, measured and weighed. Ground diameter, stump diameter (at 10 cm), DBH and total height were measured for each tree in the sample. When poles were cut from the stem, their length and diameter were also measured. Weights of poles, branches of more than 2 cm in diameter (fuelwood) and leaves and smaller branches were weighed separately on a 40 kg or 10 kg scale. Samples from each section of the tree were collected as soon as the tree was felled and stored in airtight bags for laboratory analysis to determine moisture content and specific gravity.

Results

Laboratory analysis of the tree samples revealed a moisture content of the merchantable section of the trees (poles and fuelwood) of 44% and a specific gravity of 0.59 gr/mm^3. The remaining biomass, mainly small branches, twigs and leaves contained 69 gr of water for every 100 gr of green biomass.

Statistical analysis of field data revealed high positive correlations between DBH (diameter at 130 cm) or stump diameter (at 10 cm) and fuelwood, total biomass and merchantable volume production. However, when only the volume of poles as defined and cut in the field is taken into account, the correlation between DBH or stump diameter and pole volume becomes less evident. This is due to the fact that tree cutters apply different standards to the definition of a "pole" as a function of their own needs for construction timber and fuelwood products, rather than as a function of diameter, length or form. The definition of "charcoal wood" seemed to be more precise (applying more precise standards). Tree cutters appear to have greater experience and are more familiar cutting a tree for charcoal than for poles and logs.

Nevertheless, approximately 56% of all merchantable wood volume was cut into "poles" with an average length of 3.2 meters and an average diameter (at midsection) of 8.2 cm. Charcoal wood constituted about 39% of the total merchantable volume, while the remaining 5% was cut into logs (saw-timber). Non-merchantable biomass represented 26% of all green biomass weight. The average tree in the sample had a DBH of 8 cm, a total height of 7.5 meters and weighed approximately 85 kg (green weight).

Fuelwood Production

Table 1-A presents estimates of fuelwood yields of *Leucaena leucocephala* in this five year old stand. The table assumes that the entire tree was used for fuelwood production. Fuelwood yields are expressed in terms of dry weight kilograms for comparison with other sites and across seasons. Moisture content would probably, vary as a function of seasonal changes, site conditions and rainfall pattern.

The amount of fuelwood production can be estimated using DBH (cm) as the only field measurement and the number of trees in each diameter class. Assuming a conversion factor of 0.45 (Tymian, 1984), this table can also be used to estimate charcoal production. Figure 1-A shows the fuelwood production curve as a function of DBH: dry fuelwood (kg) = 0.817 x Basal Area (cm^2) - 2.707 x DBH (cm), which has an r^2 = 98%.

Total fuelwood production (kg) is estimated in Table 1-B as a function of stump diameter (at 10 cm). This table can be used to estimate fuelwood production after the tree has already been cut and only the stump can be measured. As in the case of

Table 1-A, a charcoal conversion factor of 0.45 should enable one to estimate charcoal production as a function of stump diameter. The equation: dry fuelwood (kg) = 0.274 stump diameter squared (cm^2), defines the fuelwood production function with a 97% determination coefficient.

Finally, Table 1-C displays total biomass (dry weight of merchantable + non-merchantable sections of the tree) as a function of DBH. The expression: dry biomass (kg) = 0.667 x Basal Area (cm^2) enables the estimation of biomass production, using DBH as the only field measurement (r^2 = 97%). Total biomass weight provides a standard measure of tree yield for purposes of comparison, independent of seasonal variations or unique definitions for merchantable wood sections (i.e.,poles).

Conclusions

Leucaena leucocephala produces in general, considerable amounts of fuelwood. The form of the tree stem does not however, consistently produce high quality timber (logs, poles). Local demand for construction timber does appear however, to tolerate a great range of variation in length, diameter and shape. This tree species has proven to adapt well to difficult edaphic and climatic conditions in every region of Haiti. Its potential as a fuelwood tree is unquestionable. Possibly, provenance studies and careful selection of seed trees could identify tree stock with a better form, thus increasing its usefulness as a producer of timber, while maintaining its characteristics as a fast growing and adaptable tree.

Moreover, a coppicing experiment established in the summer of 1985 near Cap Haitien, should more clearly outline the potential of *Leucaena* to produce on a short rotation, quality polewood and an abundance of fuelwood. Throughout the analysis, *Leucaena* demonstrated greater variance than any other tree species studied. It is suggested therefore, that more samples of this species be studied to more accurately determine the productive potential of this species in the Haitian, highly diverse countryside. As a result, the yield tables estimated in this study could be adjusted in order to predict with confidence, production levels of fuelwood and polewood over the range of environmental conditions in Haiti.

Fuelwood and Biomass Production of *Cassia siamea* near Limbe (Haiti)

Cassia siamea (Lam.) is a native to Southeast Asia, yet throughout the tropics has appeared to adapt well and is becoming a favorite of fuelwood plantations for its fast growth, the quality of its wood and good stem form. It has been successfully used by the Agroforestry Outreach project in Haiti on sites with adequate (more than 1000 mm) annual rainfall and good to average soils.

One large plantation of *Cassia* was established on a plain near the Riviere Salee (Limbe), in the northern region of Haiti. The trees were planted in the spring of 1980 at a spacing of 2.5 by 2.5 meters. This same density remains five years later and gives the impression of an overly dense plantation. Although the canopy is not fully closed, trees do have to compete for scarce nutrients in the soil.

Soils at this site vary greatly. There are pockets of deep rich soils as there are salt flats, where tree growth is clearly stunted. Depth, structure and pH vary accordingly. The soil most commonly represented on the plantation is 15 to 20 cm deep, dark brown to black, rich in clay, poor drainage and a fragmented limestone substrat . pH ranges from very alkaline (pH from 8 to 9) on the salt flat to slightly alkaline (pH 7-8) at the base of a small hill on the northern end of the plantation site. Annual rainfall over this area averages around 2000 mm. The area is situated at an elevation of less than 100 masl and falls within the humid/very humid sub-tropical forest (Holdridge, 1963) and Buffum/Campbell Zone 35.

Method

Thirty-one trees ranging in diameter (at 130 cm) from 1 to 14 cm were cut, measured and weighed. Data collection and sampling techniques reflect the methodology developed for the Regional Fuelwood Project in Central America (CATIE, 1984). DBH, stump diameter (at 10 cm) and ground diameter were measured for each tree sampled. Measures of total tree height as well as pole length and diameter, were also taken. From each tree cut, samples of the merchantable sections of the tree as well as from the leaves and small branches were collected for laboratory analysis to determine moisture content and specific gravity.

Results

The average tree in the sample had a DBH of 7 cm, a total height of 8.5 meters and weighed approximately 42 kg (green weight). Non-merchantable portions of the tree (leaves and small branches, less than 2 cm in diameter) constituted 21% of all green biomass weight. Almost 60% of all biomass (and 75% of all merchantable volume) was cut into either poles or logs. Sixty

percent of all trees sampled produced at least one pole. Of these, about half produced a second pole, and those with a DBH greater than 13 cm, produced a small butt log, with lumber potential. Only 19% of the total weight was separated as having only fuelwood potential.

Statistical analysis of the field data indicated that the average tree in the sample produced a considerable amount of merchantable volume consisting of one part fuelwood for every three parts of construction timber. As in the case of *Leucaena*, the size standards which defined poles and logs in the field varied greatly, with pole form being the least important of all considerations. Charcoal wood, on the other hand, was easily separated from non-merchantable wood. Familiarity with charcoal making as opposed to cutting trees for timber, could explain the significant variance in pole size standards. Most peasants cut trees for their own construction needs rather than for the pole market.

Laboratory analysis of the tree samples taken determined a dry versus green weight ratio of 0.50 (50% moisture content) for the merchantable sections of the tree and 0.42 for the leafy parts. Specific gravity of the wood samples was calculated at 0.57 gr/mm^3. The leaves, pods and seeds of this species contain a substance toxic to pigs, but not to cattle and goats (NAS, 1980). Sawdust from wood cutting is also irritant to the human skin.

Fuelwood Production

In the site conditions described above, *Cassia* produces about one third less dry fuelwood (weight) than *Leucaena leucocephala* (growing on a hillside in the southwest of Haiti). Table 2-A shows fuelwood production (kg) as a function of DBH. This table enables one to estimate fuelwood production by only measuring DBH and counting the number of trees in each diameter class. The function that predicts fuelwood production is: dry fuelwood (kg) = 0.55 x Basal Area (cm^2) - 1.5 x DBH (cm), with a determination coefficient of 97%. Figure 2-A graphically displays this expression.

Table 2-D displays estimates of pole volume production in cubic decimeters, as a function of DBH. Its squared value (Basal Area) is used for better approximation. The function used to produce the volume table is: pole volume (m^3,1000) = 0.043 x Basal Area (cm^2); the r^2 is 91%. Figure 2-B shows polewood production in graphic form as a function of DBH.

Table 2-B enables the estimation of fuelwood yield for any given tree, when only the stump can be measured in the field. The equation: dry fuelwood (kg) = 4.0 x stump diameter (cm) - 9.5 x square root of stump diameter (cm) was used to prepare Table 2-B, with an r^2 of 86%.

In order to permit comparisons across sites and seasons, Table 2-C provides an estimate of total biomass production according to the function: dry biomass (kg) = 0.5 x Basal Area (cm^2) with a determination coefficient of 96%.

Conclusions

Cassia siamea displays far less variance than *Leucaena* in the distribution of DBH, height and fuelwood production. Generally, the stems are more regular, although often multiple. Pole production is therefore, more consistent as a function DBH and height. Correlation coefficients among these parameters are consistently high. Variation in DBH and height of *Cassia* can be attributed to varying site conditions, principally soil quality and drainage. On average sites in Haiti with good rainfall (above 1000 mm) *Cassia siamea* could prove to be a good fuelwood tree, with good to very good potential for producing construction timber.

Fuelwood and Biomass Production of *Azadirachta indica* (Neem) near Thomazeau (Haiti)

This tree is one of the most popular exotic tree species in Haiti. It is commonly planted as an ornamental tree in courtyards and alongside roads. Neem is also widely used in reforestation for its adaptability and considerable tolerance for poor soils and droughts. Where moist and well drained soils prevail, *Azadirachta indica* is definitively one of the better fuelwood trees available. Its foliage is non-edible even to goats, which makes it an especially attractive tree species to be planted in open range areas. Used as green manure it is very effective in restoring nutrients to the soil. Its seeds produce a chemical compound (azadirachtin) used as an insect repellent and an oil used in burning lamps (NAS, 1980).

The sample of trees used in this study was obtained from an arid area in the Cul de Sac, in the southern region of Haiti. Much of this plantation, established in the fall of 1982 by Operation Double Harvest (ODH) has failed due to poor soils, poor drainage and extremely low rainfall (600-700 mm). Soils in this area are very shallow, light brown with a hard layer of clay found at less than 60 cm. The pH has been found to vary between 8 and 9, with some areas extremely saline, where practically nothing grows. The area is located at sea level and can be reached within an hour drive from Port-au-Prince. The area is included in the dry sub-tropical forest zone (Holdridge, 1963) and in the Buffum/Campbell Zone 17. Only a portion of the entire plantation, located in an area previously farmed and irrigated, has survived. There, neem and *Leucaena* trees have grown into a thin stand from which 22 trees were cut, measured and weighed.

Method

Following the methodology developed by the CATIE Regional Fuelwood Project (1984) the trees were measured at DBH (at 130 cm), ground and stump diameter (10 cm) and for total height. Once felled, the tree was sectioned in polewood, charcoal wood and non-merchantable biomass. Leaving to the local tree cutters (local peasants) the definition of pole and charcoal wood, samples were taken from each section for subsequent determination of moisture content and specific gravity in the laboratory. The entire tree biomass was weighed (except for a 10 cm stump and the root system) as soon as the tree was cut, using a 10 kg and a 40 kg scale. Each section of the tree was weighed separately. Poles were measured for length, as well as top and bottom diameters.

Results

Laboratory analysis of the tree samples determined that pole and charcoal wood contained moisture equivalent to 46% of their green weight. The specific gravity of wood was calculated

at 0.58 gr/mm³. Leaves and small branches contained greater amounts of water by weight (dry/green weight ratio = 0.35), losing two thirds of their water when placed in an oven at 80 degrees centigrade for 24 to 36 hours.

Statistical analysis of the data collected in the field shows that DBH and stump diameter correlated very significantly ($p < .001$) with the tree's fuelwood yields, pole volume and total biomass production. Tree height on the other hand, though positively correlated, is a less reliable indicator of fuelwood, biomass production and pole volume. It should be noted that, the local peasant hired to cut the trees in this sample, spontaneously decided to cut poles (from suitable trees) of a uniform length (3.1 meters). This decision was aided by the straight form of most trees in the plantation and possibly, by the tree cutter's familiarity with the requirements of the pole market in the urban area nearby. This is in contrast with other regions of Haiti where secondary markets for polewood do not exist and standards for construction timber are dictated by the peasant's personal needs.

The average neem tree in this sample, had a DBH of 6.8 cm, a stump diameter of almost 10 cm, a total length (entire tree) of 5.9 meters and weighed approximately 37 kg. Every tree having a DBH greater than 6 cm produced one pole, 3.1 meter long, with an average midpoint diameter of 9.1 cm (volume = 0.006 m³). About 36% of all biomass weight is represented by poles, 23% by charcoal wood and 41% by leaves and small branches.

Further analysis of field data revealed that neem produces between 40 and 50% less fuelwood than *Leucaena* for any given diameter (DBH) class. Poles produced from trees of diameter (at 1.30 m) greater than 6 cm, were generally straight, though tapered significantly. More than 50% of all trees (13) produced one pole each. Variance across the entire sample was small for merchantable weight and pole volume, even when site conditions varied considerably.

Fuelwood Production

Estimates of fuelwood (the portion of biomass usable for charcoal or firewood production) yields for different size neem trees are presented in Table 3-A. Yields are expressed in kilograms dry weight to be comparable across seasons and sites. Fuelwood production can be estimated using the function: fuelwood (kg) = 0.36 x Basal Area (cm²) - 0.71 x DBH (cm), with an almost perfect coefficient of determination (r^2 = 99%). Figure 3-A displays the production function graphically.

Fuelwood production estimates for neem as a function of stump diameter are shown in Table 3-B and calculated by applying the function: fuelwood (kg) = 0.2 x stump diameter squared (cm²) - 1.02 x stump diameter (cm), with a determination coefficient of 98%. This table enables the estimation of

fuelwood production from trees already harvested, when only the stump (at 10 cm) can be measured in the field.

A volume table for poles is presented in Table 3-D. The function that estimates pole production: pole volume ($m^3/1000$) = 0.029 x Basal Area (cm^2) has an r^2 = 97%. Figure 3-B displays polewood volume production of neem, graphically.

Finally, total biomass production is reported as a function of DBH in Table 3-C. Dry biomass production is estimated by the equation: dry biomass (kg) = 0.4 x Basal Area (cm^2) with a determination coefficient of 98%.

Conclusions

Azadirachta indica (neem) appears to combine many features to make it one of the most attractive reforestation trees in Haiti. Adaptability, tolerance of climatic and edaphic extremes and especially, good initial growth and excellent stem form are features appealing to foresters and to the Haitian peasants. If its seeds could find widespread utilization for producing lamp oil and as an insecticide, the usefulness of this species would be extraordinary.

Fuelwood and Biomass Production of *Colubrina arborescens* (Bois Kapab) on the mountain slopes around Morne-a-Cabrit (Haiti)

Colubrina arborescens, known locally as "bois kapab", is a native tree species commonly used in traditional agroforestry associations on many mountain slopes of Haiti. Found mostly at higher elevations (above 400 masl) and in humid areas, this tree grows relatively quickly into a tall tree with a small crown and a straight stem. It can withstand heavy pruning and thus is often found in farm plots among food crops such as beans, maize, sweet potatoes and manioc. This species is not well known outside of the island of Hispaniola and is not listed among the firewood crops by the NAS (1980) and CATIE (1985). Along with *Catalpa longissima* (Bois chene), kapab represents one of the most promising agroforestry tree species found growing on the humid hillsides of Haiti.

Method

The sample of trees cut for this study was found with the cooperation of the Soil Conservation and Watershed Management Section of the Ministry of Agriculture. Between five and six year ago, agronomists from this section distributed a great number of *Colubrina arborescens* (Kapab) seedlings among the peasants of a farmers' cooperative. All the trees in this sample were growing within planted fields and were pruned to varying degrees. In exchange for other tree seedlings (Catalpa, Eucalyptus) the peasants from Morne-a-Cabrit allowed 18 kapab trees of different sizes to be cut for this study.

The area from where the sample was taken is located on a mountain range just north of Port-au-Prince, Haiti (Chaine des Metheux), at an altitude of 700 to 800 meters above sea level and situated on very steep slopes with shallow soils over a calcareous substrate (pH 8-9). The area throughout is intensively farmed, mostly with annual food crops. A number of fruit trees (avocado) and coffee plants can be also found. Rainfall varies from 1400 to 1800 mm annually. The region is included in the humid to very humid sub-tropical forest of the Life Zone classification (Holdridge,1963) and in the Buffum/Campbell Zone 51.

Results

Samples taken from trees cut in the field were processed and analyzed in the laboratory at the Faculty of Agronomy, near Damien, on the outskirts of Port-au-Prince. The wooden sections of the Kapab show a moisture content ratio (dry over green weight) of 0.53 and a specific gravity of 0.55 gr/mm^3. The non-merchantable biomass (mainly leaves and small branches) contained moisture equivalent to almost twice the dry biomass weight. The wood is characterized by a red heartwood and a

pungent odor when cut. Although the wood appears soft, the tree stem is generally straight and is commonly used as polewood.

Correlation coefficients between DBH or stump diameter and fuel weight and total biomass are significant ($p < .001$). The same parameters correlated with pole volume with a correlation coefficient (r) of only 0.75. Half of the trees sampled in the sample produced a pole with an average length of 3.2 meters and a middle diameter of almost 7 cm. Seventy two percent of all biomass weight is represented by either poles or charcoal wood. The remaining 28% being leaves and small branches. The avearge tree in the sample had a DBH of 5.4 cm, is 5 meters long and weighed in the field only 19 kg (about half the weight of a leucaena tree of comparable size). This latter value is however, misleading as most trees sampled were pruned considerably, in the agroforestry tradition of local peasants. The base of the tree is generally, bell-shaped and its perimeter ondulated. As in other species studied, height of the tree is a poor indicator of the yield parameters (fuelwood, polewood and total biomass).

Fuelwood Production

Table 4-A displays estimated fuelwood yields for ***Colubrina arborescens*** as a function of DBH according to the expression: dry fuelwood (kg) = 0.26 x Basal Area (cm^2), with an r^2 of 98%. In general, Bois kapab produces, far less fuelwood than Leucaena, yet it is suited in higher elevations, on poor soils and produces a good number of poles of excellent form. *Colubrina* coppices well and its production potential under this management practice should be evaluated.

In order to estimate fuelwood production as a function of stump diameter (the only measure possible when the tree is already cut), Table 4-B presents estimated yields of fuelwood according to the function: dry fuelwood (kg) = 0.36 x stump diameter squared (cm^2) - 0.43 x stump diameter (cm), with a determination coefficient of 97%.

Total biomass production potential (dry weight) is presented in Table 4-C. These values can be used for comparison of yields across sites and seasons. The expression: dry fuelwood (kg) = 0.32 x Basal Area (cm^2) has an r^2 of 98% and was used to calculate the yields in the table.

Conclusions

Unfortunately, very little is known about this tree species, its ecology and its potential uses in the context of reforestation and fuelwood production. The use of "bois kapab" in the traditional agroforestry systems on the Haitian hillsides, makes it especially attractive as a tree to be used in reforestation on the humid highlands of Haiti.

Fuelwood and Biomass Production of *Eucalyptus camaldulensis* in a plantation in southern Haiti

This species of *Eucalyptus* is the one most commonly planted in Haiti. It has proven tolerant to prolonged dry seasons and thin topsoil. It grows best however, in deep and moist soils. In optimal conditions, it would appear to share the same habitat requirements as *Catalpa longissima* (bois chene). Provenance seems to be a key element for successful establishment of this species in any less than ideal environmental conditions (NAS, 1980). It remains a favorite of peasants throughout Haiti and is extensively used by the Agroforestry Outreach Project.

This report analyzes the fuel and polewood production potential of *Eucalyptus camaldulensis* Dehnh. on a plantation (Madsen Farms) located near Port-au-Prince, in the southern region of Haiti. This large plantation (51 ha) was established by Operation Double Harvest (ODH) in the fall of 1981. It includes mostly *Leucaena leucocephala* and *Azadirachta indica*, and to a lesser extent, other tree species.

Rainfall in this area averages about 900 to 1000 mm per year. The soil is alkaline with a pH ranging from 8 to 9. There are frequent pockets of salt concentration due to excessive irrigation in the past. On the saline site, *Eucalyptus* as well as other species, grew very little. The area falls within the dry sub-tropical forest zone of the Holdridge life zone classification (1963) and its located on a plain at sea level, previously planted with sugar cane. The study site is located within the Buffum/Campbell Zone 17.

Method

A random sample of 21 trees was selected from different diameter classes, cut, measured and weighed according to the methodology developed for the Fuelwood Project in Central America (CATIE, 1984). Samples were taken from at least two trees in each diameter class for moisture content and specific gravity determination. Each tree was measured for DBH (at 1.3 m), ground and stump diameters (at 10 cm) and weighed in sections. Poles were cut according to the standards of the tree cutter, hired locally. Similarly, charcoal wood was cut from tree sections that were either too small or were too crooked to be made into poles. It must be mentioned that the tree cutter involved in cutting this sample tended to cut "long" poles (average length of 4.4 meters).

Results

Statistical analysis of the field data revealed that dry fuel weight (kg), total biomass (kg) and pole volume (m^3) correlated significantly ($p < 0.001$) with both DBH and stump

diameter. Even tree height, though not as significant, correlated highly with these yield parameters (correlation coefficient = 0.89). Still DBH, and especially basal area, turn out to be the best indicator of tree yields at any given diameter. Fifty-four percent of total biomass weight was cut into poles, 19% into charcoal wood and the remaining 27% was separated as non-merchantable biomass. Two thirds of all trees produced one pole which averaged 8.5 cm diameter at the middle and 4.4 meters in length.

Fuelwood and Polewood Production

Table 5-A presents estimated fuelwood production values (dry weight) as a function of DBH (cm), while assuming that the entire merchantable biomass is transformed into fuelwood. The function used for this determination is: dry fuelwood (kg) = 0.24 x Basal Area (cm^2), with an r^2 coefficient of 98%. The table shows that *Eucalyptus* produces far less fuelwood than *Leucaena*, when site conditions are assumed similar.

Total biomass production (kg) is displayed in Table 5-C. The function: dry biomass (kg) = 0.32 x Basal Area (cm^2) is used to estimate biomass as a function of DBH with a determination coefficient of 99%. DBH is the only field measure required to estimate fuelwood and biomass production using the above tables. When the tree is already cut, but the stump diameter can still be measured, Table 5-B allows the estimation of fuelwood production for previously harvested trees.

Polewood production was also estimated as a function of DBH (cm) using the expression: polewood volume (m^3/1000) = 0.037 x Basal Area (cm^2), with a determination coefficient of 96%. Table 5-D constitutes a pole volume table for *Eucalyptus camaldulensis*. The values in the pole volume table are in expressed in cubic decimeters. This unit is used since, tree volume values expressed in cubic meters are naturally extremely small. For example, the average pole in the sample studied had a volume in cubic meters of 0.025. It takes forty poles of similar size to total one cubic meter.

Conclusions

Eucalyptus camaldulensis offers great potential as a producer of construction timber. For fuelwood production, its potential is more limited. Its limitations were obviously aggravated by poor site conditions, where other tree species would out-perform Eucalyptus easily. Consideration should be given to compare different provenances of this *Eucalyptus* species to obtain the best results. One provenance of this tree species has done very well in northern Africa (Morocco), possibly in similar ecological conditions as those found in many parts of Haiti. The coppicing potential of this species also needs to be explored.

Fuelwood and Biomass Production Potential of *Prosopis juliflora* (Bayahonde) in the Cul de Sac region of Haiti

Prosopis juliflora Swartz, is the most common dry area tree species in Haiti. It grows exceptionally well in arid zones, with rainfall of less than 400 mm annually. It also tolerates very alkaline soils, where other trees cannot adapt. It is a favorite of charcoal makers for the quality of the charcoal it produces. Its green biomass is used for forage, yet in the open range, it is avoided by goats because of its abundant thorns. *Prosopis* coppices well and then produces straight stems used as poles in construction. The wood is durable and used for fence posts and door and window frames. It is the favorite firewood tree in rural areas as it burns slowly and evenly.

The potential of *Prosopis* in reforestation of eroded hillsides has yet to be tapped. Many eroded slopes in the country could recuperate their vegetative cover quickly and cost effectively, if "bayahonde" were allowed to regrow naturally and not be harvested on a short rotation for charcoal production. It reproduces easily by root suckers as well as seed (NAS, 1980).

Method

The samples used for preparation of the yield tables were cut from various sites in the Cul de Sac (Ganthier) and near Duvalierville (in the southern region of Haiti). Rainfall at Ganthier, an area at sea level, east of Port-au-Prince averages about 700 mm per year. At Duvalierville, north of the capital city, rainfall is about 900 mm annually, with extended dry seasons having no rains at all. While the trees samples near Ganthier were typical of courtyard trees, coppiced and used frequently for domestic fuel production, the trees cut near Duvalierville, had been let to grow for several years. The yield tables therefore, reflect some of the variability within which this tree species grows in Haiti.

A total of 20 trees was cut, measured and weighed in sections according to the methodology developed for the Regional Fuelwood Project in Central America (CATIE, 1984). Each tree was separated in merchantable (more than 2 cm minimum diameter) and non-merchantable wood (mostly leaves and small branches). The merchantable wood was divided in polewood (if a pole could be cut from the stem) and charcoal wood and weighed separately. The remaining biomass was also weighed as soon as the tree was felled. Each tree was measured for DBH, stump and ground diameters, as well as total height. Poles were measured for length and top and bottom diameters.

Results

The analysis of the tree samples in the laboratory determined that the specific gravity of *Prosopis juliflora* was 0.72 gr/mm^3, the moisture content of wood samples represents 36% of total green weight, while that of the leaves and small branches is 51%. The heartwood of *Prosopis* is almost black in color, quite hard, dense and heavy.

Statistical analysis of the field data determined that DBH and stump diameter correlated highly only with fuel weight and dry biomass production ($p < .001$), while pole volume correlated with these parameters poorly. Total height of the tree turned out to be a very poor indicator of all yield parameters, such as fuel and biomass weight and showed no significant correlation with pole volume.

A total of nine poles was cut from the 20 trees sampled. Their length ranged from 1.8 to 3.7 meters with an average diameter of 7.6 cm. More than two thirds of the total tree weight was accounted for by either pole or charcoal wood at a ratio of 1 to 2 respectively. Leaves, twigs and small branches accounted for 32% of all biomass weight (generally higher than in other species). Although the form of the trees cut was very irregular, the peasants involved in cutting the trees, did cut a number of poles to be used on local construction sites, but neither size and form of the poles could meet urban market requirements.

The average tree in the sample was about 6 meters tall and had a DBH of 6.1 centimeters and weighed 31 kilograms. A number of trees were growing from old stumps, thus being in effect, coppices. Few "bayahonde" trees in Haiti have never been cut before. In fact, relative large stands of "bayahonde" can be found that are intensively, yet rationally managed as coppice stands. Further research in appropriate silvicultural techniques for this promising species are definitively warranted.

Fuelwood Production

Fuelwood production potential of *Prosopis juliflora* is evaluated in Table 6-A according to the formula: dry fuelwood (kg) = 0.39 x Basal Area (cm^2). The determination coefficient for this function is 99%. According to this table, a tree with a DBH of 10 cm will produce on the average, 30 kg of dry fuelwood. When only the stump diameter (at 10 cm) can be measured (the tree has been cut already) Table 6-B permits the estimation of fuelwood production as a function of stump diameter. The function used: dry fuelwood (kg) = 0.19 x stump diameter squared (cm^2) has a determination coefficient of 97%.

In order to allow comparisons across sites and seasons, Table 6-C enables estimation of total biomass production (dry weight) as a function of DBH. The expression used: dry biomass (kg) = 0.52 x Basal Area (cm^2), has a determination coefficient of 97%.

Conclusions

Field observations across Haiti clearly show the tremendous potential of this species in the arid zones of the country. Few other tree species can outperform "bayahonde" in fuelwood production on difficult sites and in semi-desert conditions. Further research in the potential of this tree under different management conditions could indicate ways of maximizing production of fuelwood and ways to utilize this tree in reforestation of marginal areas of the country.

APPENDIX A

FIGURES AND TABLES

FOR

LEUCAENA LEUCOCEPHALA

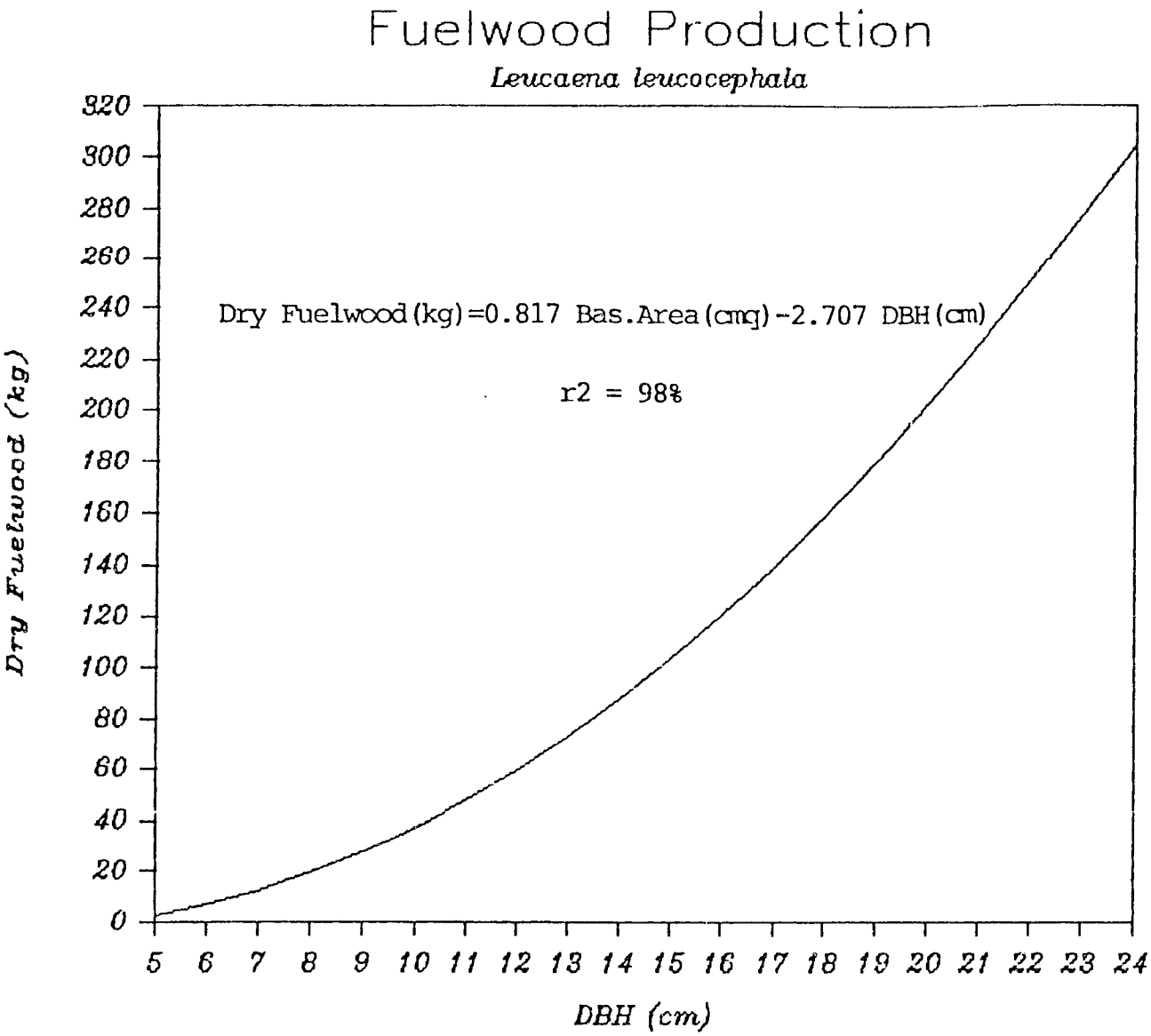

Figure 1A. Fuelwood production for Leucaena leucocephala in Haiti as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of DBH (cm).

Leucaena leucocephala - July 1985.

Dry Fuelwood (kg)=0.817 Bas.Area(cmq) - 2.707 DBH (cm); r2 = 98%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
5	19.64	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.[illegible]	22.6	25.1
6	28.27	6.9	13.7	20.6	27.4	34.3	41.1	48.0	5[illegible].9	61.7	68.6
7	38.48	12.5	25.0	37.5	50.0	62.5	75.0	87.5	99.9	112.4	124.9
8	50.27	19.4	38.8	58.2	77.6	97.1	116.5	135.9	155.3	174.7	194.1
9	63.62	27.6	55.2	82.8	110.4	138.1	165.7	193.3	220.9	248.5	276.1
10	78.54	37.1	74.2	111.3	148.4	185.5	222.6	259.7	296.8	333.9	371.0
11	95.03	47.9	95.7	143.6	191.5	239.3	287.2	335.1	382.9	430.8	478.7
12	113.10	59.9	119.8	179.8	239.7	299.6	359.5	419.4	479.3	539.3	599.2
13	132.73	73.3	146.5	219.8	293.0	366.3	439.5	512.8	586.0	659.3	732.5
14	153.94	87.9	175.7	263.6	351.5	439.3	527.2	615.1	703.0	790.8	878.7
15	176.72	103.8	207.5	311.3	415.1	518.9	622.6	726.4	830.2	933.9	1037.7
16	201.06	121.0	241.9	362.9	483.8	604.8	725.7	846.7	967.6	1088.6	1209.6
17	226.98	139.4	278.8	418.3	557.7	697.1	836.5	976.0	1115.4	1254.8	1394.2
18	254.47	159.2	318.4	477.5	636.7	795.9	955.1	1114.2	1273.4	1432.6	1591.8
19	283.53	180.2	360.4	540.6	720.8	901.1	1081.3	1261.5	1441.7	1621.9	1802.1
20	314.16	202.5	405.1	607.6	810.1	1012.6	1215.2	1417.7	1620.2	1822.8	2025.3
21	346.36	226.1	452.3	678.4	904.5	1130.7	1356.8	1582.9	1809.0	2035.2	2261.3
22	380.13	251.0	502.0	753.0	1004.1	1255.1	1506.1	1757.1	2008.1	2259.1	2510.2
23	415.48	277.2	554.4	831.6	1108.7	1385.9	1663.1	1940.3	2217.5	2494.7	2771.8
24	452.39	304.6	609.3	913.9	1218.5	1523.2	1827.8	2132.4	2437.1	2741.7	3046.3

USAID/AFORP/UMO/Ehrlich, 1985.

Table 1A. Production of Leucaena fuelwood (dry weight) as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of stump diameter (cm).

Leucaena leucocephala - July 1985.

Dry Fuelwood (kg)=0.2745*Stump sqr.(cmq); r2 = 97%

Stump (cm)	Stump sqr (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	4	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	11.0
3	9	2.5	4.9	7.4	9.9	12.4	14.8	17.3	19.8	22.2	24.7
4	16	4.4	8.8	13.2	17.6	22.0	26.4	30.7	35.1	39.5	43.9
5	25	6.9	13.7	20.6	27.5	34.3	41.2	48.0	54.9	61.8	68.6
6	36	9.9	19.8	29.6	39.5	49.4	59.3	69.2	79.1	88.9	98.8
7	49	13.5	26.9	40.4	53.8	67.3	80.7	94.2	107.6	121.1	134.5
8	64	17.6	35.1	52.7	70.3	87.8	105.4	123.0	140.5	158.1	175.7
9	81	22.2	44.5	66.7	88.9	111.2	133.4	155.6	177.9	200.1	222.3
10	100	27.5	54.9	82.4	109.8	137.3	164.7	192.2	219.6	247.1	274.5
11	121	33.2	66.4	99.6	132.9	166.1	199.3	232.5	265.7	298.9	332.1
12	144	39.5	79.1	118.6	158.1	197.6	237.2	276.7	316.2	355.8	395.3
13	169	46.4	92.8	139.2	185.6	232.0	278.3	324.7	371.1	417.5	463.9
14	196	53.8	107.6	161.4	215.2	269.0	322.8	376.6	430.4	484.2	538.0
15	225	61.8	123.5	185.3	247.1	308.8	370.6	432.3	494.1	555.9	617.6
16	256	70.3	140.5	210.8	281.1	351.4	421.6	491.9	562.2	632.4	702.7
17	289	79.3	158.7	238.0	317.3	396.7	476.0	555.3	634.6	714.0	793.3
18	324	88.9	177.9	266.8	355.8	444.7	533.6	622.6	711.5	800.4	889.4
19	361	99.1	198.2	297.3	396.4	495.5	594.6	693.7	792.8	891.9	990.9
20	400	109.8	219.6	329.4	439.2	549.0	658.8	768.6	878.4	988.2	1098.0

USAID/AFORP/UMO/Ehrlich, 1985.

Table 2 A. Production of Leucaena fuelwood (dry weight) as a function of stump diameter.

YIELD TABLE

Production of total biomass (dry weight in kg)

as a function of DBH (cm).

Leucaena leucocephala - July 1985.

Dry Biomass (kg) = 0.667 Bas.Area (cmq); r2 = 97%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	2.1	4.2	6.3	8.4	10.5	12.6	14.7	16.8	18.9	21.0
3	7.07	4.7	9.4	14.1	18.9	23.6	28.3	33.0	37.7	42.4	47.1
4	12.57	8.4	16.8	25.1	33.5	41.9	50.3	58.7	67.1	75.4	83.8
5	19.64	13.1	26.2	39.3	52.4	65.5	78.6	91.7	104.8	117.9	131.0
6	28.27	18.9	37.7	56.6	75.4	94.3	113.2	132.0	150.9	169.7	188.6
7	38.48	25.7	51.3	77.0	102.7	128.3	154.0	179.7	205.4	231.0	256.7
8	50.27	33.5	67.1	100.6	134.1	167.6	201.2	234.7	268.2	301.7	335.3
9	63.62	42.4	84.9	127.3	169.7	212.2	254.6	297.0	339.5	381.9	424.3
10	78.54	52.4	104.8	157.2	209.5	261.9	314.3	366.7	419.1	471.5	523.9
11	95.03	63.4	126.8	190.2	253.5	316.9	380.3	443.7	507.1	570.5	633.9
12	113.10	75.4	150.9	226.3	301.7	377.2	452.6	528.1	603.5	678.9	754.4
13	132.73	88.5	177.1	265.6	354.1	442.7	531.2	619.7	708.3	796.8	885.3
14	153.94	102.7	205.4	308.0	410.7	513.4	616.1	718.7	821.4	924.1	1026.8
15	176.72	117.9	235.7	353.6	471.5	589.3	707.2	825.1	943.0	1060.8	1178.7
16	201.06	134.1	268.2	402.3	536.4	670.5	804.7	938.8	1072.9	1207.0	1341.1
17	226.98	151.4	302.8	454.2	605.6	757.0	908.4	1059.8	1211.2	1362.6	1514.0
18	254.47	169.7	339.5	509.2	678.9	848.7	1018.4	1188.1	1357.8	1527.6	1697.3
19	283.53	189.1	378.2	567.3	756.5	945.6	1134.7	1323.8	1512.9	1702.0	1891.1
20	314.16	209.5	419.1	628.6	838.2	1047.7	1257.3	1466.8	1676.4	1885.9	2095.4

USAID/AFORP/UMO/Ehrlich, 1985.

Table 3 A. Production of total Biomass (dry weight) as a function of DBH.

APPENDIX B

FIGURES AND TABLES

FOR

CASSIA SIAMEA

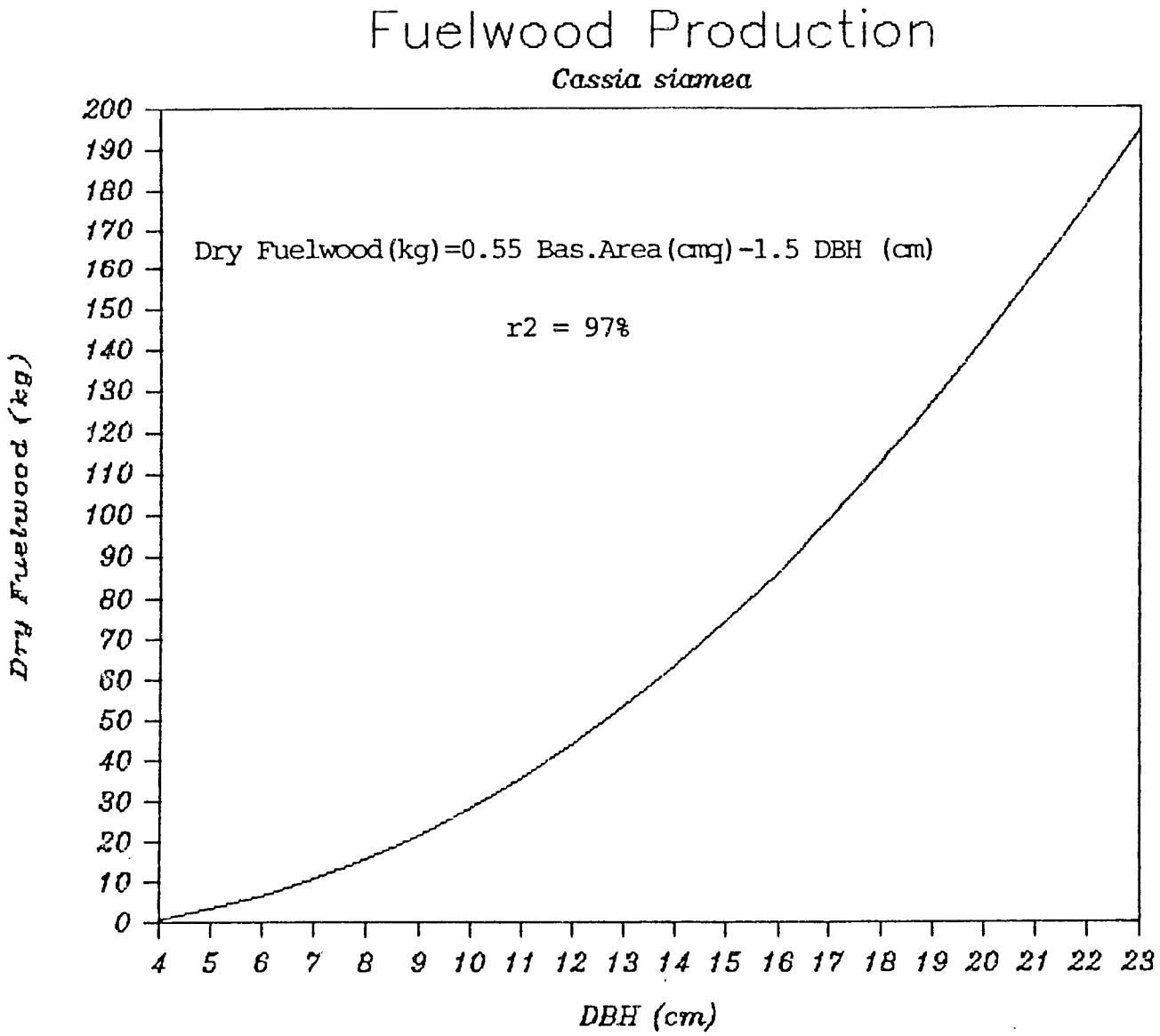

Figure 1 B. Fuelwood production of Cassia siamea (dry weight) in Haiti as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of DBH (cm).

Cassia siamea - July 1985.

Dry Fuelwood (kg)=0.551 Bas.Area (cmq) - 1.5 DBH (cm); r2 = 97%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
4	12.57	0.9	1.8	2.8	3.7	4.6	5.5	6.5	7.4	8.3	9.2
5	19.64	3.3	6.6	10.0	13.3	16.6	19.9	23.2	26.6	29.9	33.2
6	28.27	6.6	13.2	19.7	26.3	32.9	39.5	46.1	52.6	59.2	65.8
7	38.48	10.7	21.4	32.1	42.8	53.5	64.2	74.9	85.6	96.3	107.1
8	50.27	15.7	31.4	47.1	62.8	78.5	94.2	109.9	125.6	141.3	157.0
9	63.62	21.6	43.1	64.7	86.2	107.8	129.3	150.9	172.4	194.0	215.5
10	78.54	28.3	56.6	84.8	113.1	141.4	169.7	197.9	226.2	254.5	282.8
11	95.03	35.9	71.7	107.6	143.5	179.3	215.2	251.0	286.9	322.8	358.6
12	113.10	44.3	88.6	133.0	177.3	221.6	265.9	310.2	354.5	398.9	443.2
13	132.73	53.6	107.3	160.9	214.5	268.2	321.8	375.4	429.1	482.7	536.4
14	153.94	63.8	127.6	191.5	255.3	319.1	382.9	446.7	510.6	574.4	638.2
15	176.72	74.9	149.7	224.6	299.5	374.3	449.2	524.1	599.0	673.8	748.7
16	201.06	86.8	173.6	260.4	347.1	433.9	520.7	607.5	694.3	781.1	867.9
17	226.98	99.6	199.1	298.7	398.3	497.8	597.4	697.0	796.5	896.1	995.7
18	254.47	113.2	226.4	339.6	452.9	566.1	679.3	792.5	905.7	1018.9	1132.1
19	283.53	127.7	255.4	383.2	510.9	638.6	766.3	894.1	1021.8	1149.5	1277.2
20	314.16	143.1	286.2	429.3	572.4	715.5	858.6	1001.7	1144.8	1287.9	1431.0
21	346.36	159.3	318.7	478.0	637.4	796.7	956.1	1115.4	1274.8	1434.1	1593.5
22	380.13	176.5	352.9	529.4	705.8	882.3	1058.7	1235.2	1411.6	1588.1	1764.5
23	415.48	194.4	388.9	583.3	777.7	972.1	1166.6	1361.0	1555.4	1749.8	1944.3

USAID/AFORP/UMO/Ehrlich, 1985.

Table 1 B. Fuelwood production (dry weight) of Cassia siamea as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of stump diameter (cm).

Cassia siamea - July 1985.

Dry Fuelwood (kg)=4.001*(stump) - 9.461 sqr.root (stump); r2 = 86%

Stump (cm)	sqr.root Stump	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
6	2.45	0.8	1.7	2.5	3.3	4.2	5.0	5.8	6.7	7.5	8.3
7	2.65	3.0	6.0	8.9	11.9	14.9	17.9	20.8	23.8	26.8	29.8
8	2.83	5.2	10.5	15.7	21.0	26.2	31.5	36.7	42.0	47.2	52.5
9	3.00	7.6	15.3	22.9	30.5	38.1	45.8	53.4	61.0	68.6	76.3
10	3.16	10.1	20.2	30.3	40.4	50.5	60.6	70.6	80.7	90.8	100.9
11	3.32	12.6	25.3	37.9	50.5	63.2	75.8	88.4	101.1	113.7	126.3
12	3.46	15.2	30.5	45.7	61.0	76.2	91.4	106.7	121.9	137.1	152.4
13	3.61	17.9	35.8	53.7	71.6	89.5	107.4	125.3	143.2	161.1	179.0
14	3.74	20.6	41.2	61.8	82.5	103.1	123.7	144.3	164.9	185.5	206.1
15	3.87	23.4	46.7	70.1	93.5	116.9	140.2	163.6	187.0	210.4	233.7
16	4.00	26.2	52.3	78.5	104.7	130.9	157.0	183.2	209.4	235.5	261.7
17	4.12	29.0	58.0	87.0	116.0	145.0	174.0	203.1	232.1	261.1	290.1
18	4.24	31.9	63.8	95.6	127.5	159.4	191.3	223.1	255.0	286.9	318.8
19	4.36	34.8	69.6	104.3	139.1	173.9	208.7	243.5	278.2	313.0	347.8
20	4.47	37.7	75.4	113.1	150.8	188.5	226.3	264.0	301.7	339.4	377.1
21	4.58	40.7	81.3	122.0	162.7	203.3	244.0	284.7	325.3	366.0	406.7
22	4.69	43.6	87.3	130.9	174.6	218.2	261.9	305.5	349.2	392.8	436.5
23	4.80	46.6	93.3	139.9	186.6	233.2	279.9	326.5	373.2	419.8	466.5
24	4.90	49.7	99.3	149.0	198.7	248.4	298.0	347.7	397.4	447.1	496.7
25	5.00	52.7	105.4	158.2	210.9	263.6	316.3	369.0	421.8	474.5	527.2

USAID/AFORP/UMO/Ehrlich, 1985.

Table 2 B. Fuelwood production (dry weight) of Cassia siamea as a function of stump diameter.

YIELD TABLE

Production of total biomass (dry weight in kg)
as a function of DBH (cm).
Cassia siamea - July 1985.
Dry Biomass (kg) = 0.4637 Bas.Area (cmq); r2 = 96%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	1.5	2.9	4.4	5.8	7.3	8.7	10.2	11.7	13.1	14.6
3	7.07	3.3	6.6	9.8	13.1	16.4	19.7	22.9	26.2	29.5	32.8
4	12.57	5.8	11.7	17.5	23.3	29.1	35.0	40.8	46.6	52.4	58.3
5	19.64	9.1	18.2	27.3	36.4	45.5	54.6	63.7	72.8	81.9	91.0
6	28.27	13.1	26.2	39.3	52.4	65.6	78.7	91.8	104.9	118.0	131.1
7	38.48	17.8	35.7	53.5	71.4	89.2	107.1	124.9	142.8	160.6	178.5
8	50.27	23.3	46.6	69.9	93.2	116.5	139.8	163.2	186.5	209.8	233.1
9	63.62	29.5	59.0	88.5	118.0	147.5	177.0	206.5	236.0	265.5	295.0
10	78.54	36.4	72.8	109.3	145.7	182.1	218.5	254.9	291.4	327.8	364.2
11	95.03	44.1	88.1	132.2	176.3	220.3	264.4	308.5	352.5	396.6	440.7
12	113.10	52.4	104.9	157.3	209.8	262.2	314.7	367.1	419.5	472.0	524.4
13	132.73	61.5	123.1	184.6	246.2	307.7	369.3	430.8	492.4	553.9	615.5
14	153.94	71.4	142.8	214.1	285.5	356.9	428.3	499.7	571.0	642.4	713.8
15	176.72	81.9	163.9	245.8	327.8	409.7	491.7	573.6	655.5	737.5	819.4
16	201.06	93.2	186.5	279.7	372.9	466.2	559.4	652.6	745.9	839.1	932.3
17	226.98	105.3	210.5	315.8	421.0	526.3	631.5	736.8	842.0	947.3	1052.5
18	254.47	118.0	236.0	354.0	472.0	590.0	708.0	826.0	944.0	1062.0	1180.0
19	283.53	131.5	262.9	394.4	525.9	657.4	788.8	920.3	1051.8	1183.3	1314.7
20	314.16	145.7	291.4	437.0	582.7	728.4	874.1	1019.7	1165.4	1311.1	1456.8

USAID/AFORP/UHO/Ehrlich, 1985.

Table 3 B. Production of total Biomass (dry weight) of Cassia Siamea as a function of DBH.

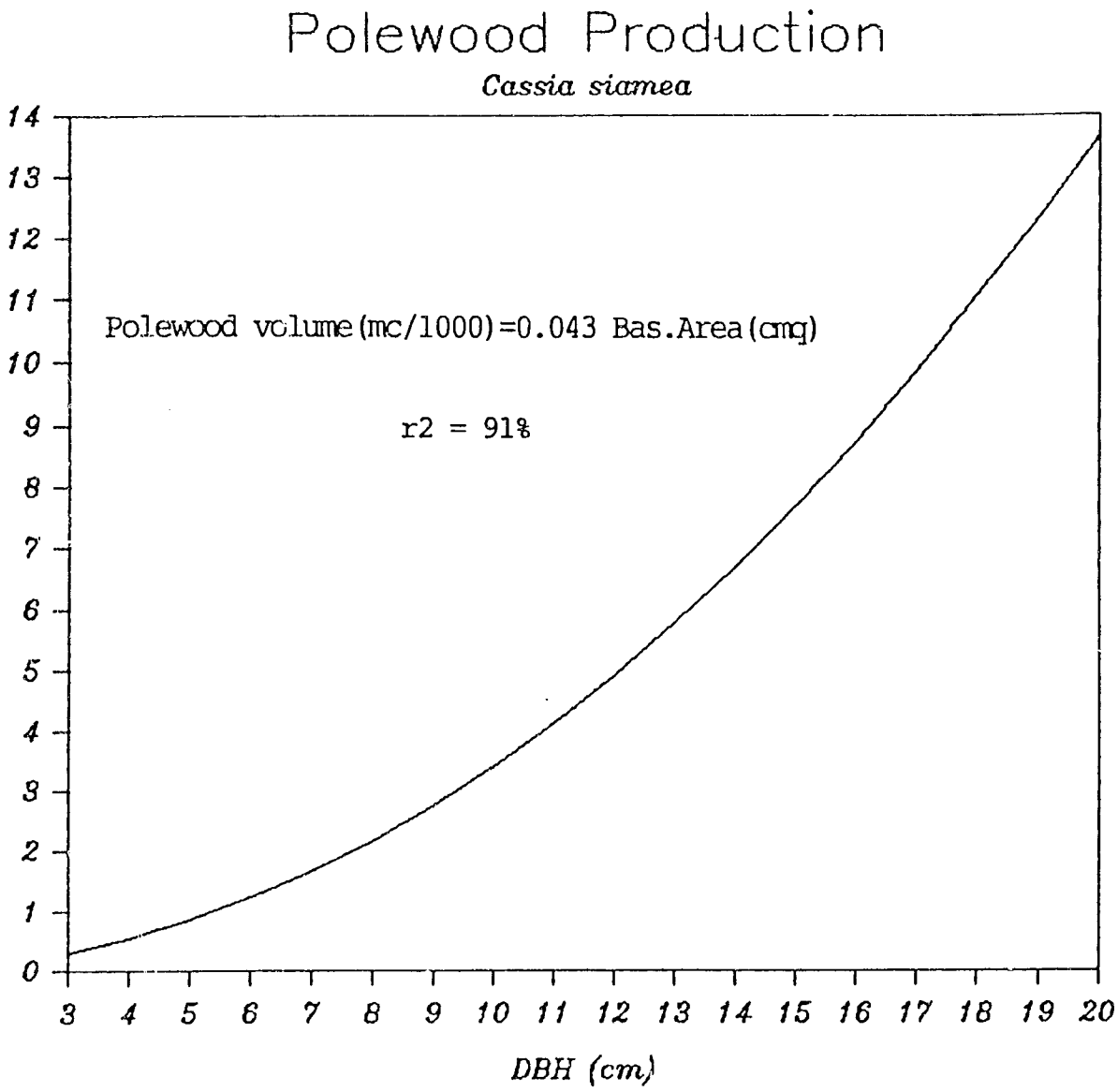

Figure 2 B. Polewood production of Cassia siamea in Haiti as a function of DBH.

YIELD TABLE

Production of polewood (volume in mc/1000)

as a function of DBH (cm).

Cassia siamea - July 1985.

Polewood volume (mc/1000) = 0.043 Bas.Area(cmq); r2 = 91%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
3	7.07	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.5	2.8	3.1
4	12.57	0.5	1.1	1.6	2.2	2.7	3.3	3.8	4.4	4.9	5.5
5	19.64	0.9	1.7	2.6	3.4	4.3	5.1	6.0	6.8	7.7	8.5
6	28.27	1.2	2.5	3.7	4.9	6.1	7.4	8.6	9.8	11.1	12.3
7	38.48	1.7	3.3	5.0	6.7	8.4	10.0	11.7	13.4	15.0	16.7
8	50.27	2.2	4.4	6.6	8.7	10.9	13.1	15.3	17.5	19.7	21.8
9	63.62	2.8	5.5	8.3	11.1	13.8	16.6	19.3	22.1	24.9	27.6
10	78.54	3.4	6.8	10.2	13.7	17.1	20.5	23.9	27.3	30.7	34.1
11	95.03	4.1	8.3	12.4	16.5	20.6	24.8	28.9	33.0	37.2	41.3
12	113.10	4.9	9.8	14.7	19.7	24.6	29.5	34.4	39.3	44.2	49.1
13	132.73	5.8	11.5	17.3	23.1	28.8	34.6	40.4	46.1	51.9	57.7
14	153.94	6.7	13.4	20.1	26.8	33.4	40.1	46.8	53.5	60.2	66.9
15	176.72	7.7	15.4	23.0	30.7	38.4	46.1	53.7	61.4	69.1	76.8
16	201.06	8.7	17.5	26.2	34.9	43.7	52.4	61.2	69.9	78.6	87.4
17	226.98	9.9	19.7	29.6	39.4	49.3	59.2	69.0	78.9	88.8	98.6
18	254.47	11.1	22.1	33.2	44.2	55.3	66.3	77.4	88.5	99.5	110.6
19	283.53	12.3	24.6	37.0	49.3	61.6	73.9	86.2	98.6	110.9	123.2
20	314.16	13.7	27.3	41.0	54.6	68.3	81.9	95.6	109.2	122.9	136.5

USAID/AFORP/UMO/Ehrlich, 1985.

Table 4 B. Production of Cassia siamea polewood volume as a function of DBH.

APPENDIX C

FIGURES AND TABLES

FOR

AZADIRACHTA INDICA

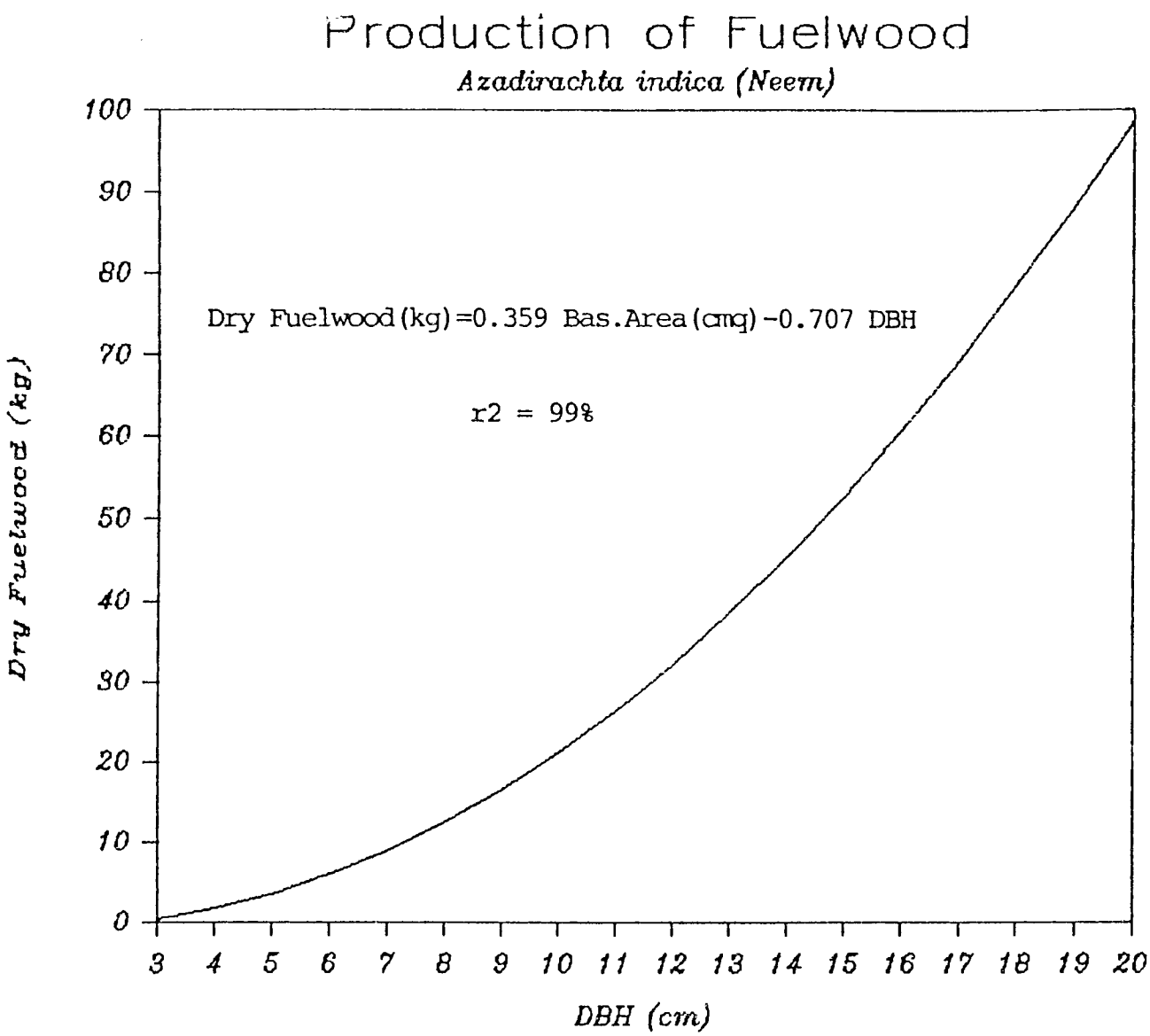

Figure 1 C. Fuelwood Production of Azadirachta indica in Haiti as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of DBH (cm).

Azadirachta indica - July 1985.

Dry Fuelwood (kg)= 0.359 Bas.Area(cmq) - 0.707 DBH(cm); r2 = 99%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
3	7.07	0.4	0.8	1.2	1.7	2.1	2.5	2.9	3.3	3.7	4.2
4	12.57	1.7	3.4	5.1	6.7	8.4	10.1	11.8	13.5	15.2	16.8
5	19.64	3.5	7.0	10.5	14.1	17.6	21.1	24.6	28.1	31.6	35.1
6	28.27	5.9	11.8	17.7	23.6	29.5	35.5	41.4	47.3	53.2	59.1
7	38.48	8.9	17.7	26.6	35.5	44.3	53.2	62.1	70.9	79.8	88.7
8	50.27	12.4	24.8	37.2	49.6	61.9	74.3	86.7	99.1	111.5	123.9
9	63.62	16.5	33.0	49.4	65.9	82.4	98.9	115.3	131.8	148.3	164.8
10	78.54	21.1	42.3	63.4	84.5	105.6	126.8	147.9	169.0	190.1	211.3
11	95.03	26.3	52.7	79.0	105.4	131.7	158.0	184.4	210.7	237.1	263.4
12	113.10	32.1	64.2	96.4	128.5	160.6	192.7	224.8	256.9	289.1	321.2
13	132.73	38.5	76.9	115.4	153.8	192.3	230.8	269.2	307.7	346.1	384.6
14	153.94	45.4	90.7	136.1	181.5	226.8	272.2	317.6	362.9	408.3	453.7
15	176.72	52.8	105.7	158.5	211.3	264.2	317.0	369.8	422.7	475.5	528.4
16	201.06	60.9	121.7	182.6	243.5	304.3	365.2	426.1	487.0	547.8	608.7
17	226.98	69.5	138.9	208.4	277.9	347.3	416.8	486.3	555.7	625.2	694.7
18	254.47	78.6	157.3	235.9	314.5	393.1	471.8	550.4	629.0	707.7	786.3
19	283.53	88.4	176.7	265.1	353.4	441.8	530.1	618.5	706.8	795.2	883.5
20	314.16	98.6	197.3	295.9	394.6	493.2	591.9	690.5	789.1	887.8	986.4

USAID/AFORP/UMO/Ehrlich, 1985.

Table 1 C. Fuelwood production (dry weight) of Azadirachta indica as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of stump diameter (cm).

Azadirachta indica - July 1985.

Dry Fuelwood (kg)= 0.2025 Stump sqr.(cmq) - 1.02 Stump (cm); r2 = 98%

Stump (cm)	Stump sqr (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
6	36	1.2	2.3	3.5	4.7	5.9	7.0	8.2	9.4	10.5	11.7
7	49	2.8	5.6	8.3	11.1	13.9	16.7	19.5	22.3	25.0	27.8
8	64	4.8	9.6	14.4	19.2	24.0	28.8	33.6	38.4	43.2	48.0
9	81	7.2	14.4	21.7	28.9	36.1	43.3	50.6	57.8	65.0	72.2
10	100	10.1	20.1	30.2	40.2	50.3	60.3	70.4	80.4	90.5	100.5
11	121	13.3	26.6	39.8	53.1	66.4	79.7	93.0	106.3	119.5	132.8
12	144	16.9	33.8	50.8	67.7	84.6	101.5	118.4	135.4	152.3	169.2
13	169	21.0	41.9	62.9	83.9	104.8	125.8	146.7	167.7	188.7	209.6
14	196	25.4	50.8	76.2	101.6	127.1	152.5	177.9	203.3	228.7	254.1
15	225	30.3	60.5	90.8	121.1	151.3	181.6	211.8	242.1	272.4	302.6
16	256	35.5	71.0	106.6	142.1	177.6	213.1	248.6	284.2	319.7	355.2
17	289	41.2	82.4	123.5	164.7	205.9	247.1	288.3	329.5	370.6	411.8
18	324	47.3	94.5	141.8	189.0	236.3	283.5	330.8	378.0	425.3	472.5
19	361	53.7	107.4	161.2	214.9	268.6	322.3	376.1	429.8	483.5	537.2
20	400	60.6	121.2	181.8	242.4	303.0	363.6	424.2	484.8	545.4	606.0
21	441	67.9	135.8	203.6	271.5	339.4	407.3	475.2	543.1	610.9	678.8
22	484	75.6	151.1	226.7	302.3	377.9	453.4	529.0	604.6	680.1	755.7
23	529	83.7	167.3	251.0	334.7	418.3	502.0	585.6	669.3	753.0	836.6
24	576	92.2	184.3	276.5	368.6	460.8	553.0	645.1	737.3	829.4	921.6
25	625	101.1	202.1	303.2	404.3	505.3	606.4	707.4	808.5	909.6	1010.6

USAID/AFORP/UMO/Ehrlich, 1985.

Table 2 C. Fuelwood production (dry weight) of Azadirachta indica as a function of stump diameter.

YIELD TABLE

Production of total biomass (dry weight in kg)
as a function of DBH (cm).
Azadirachta indica - July 1985.
Dry Biomass (kg) = 0.399 Bas.Area (cmq); r2 = 98%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	1.3	2.5	3.8	5.0	6.3	7.5	8.8	10.0	11.3	12.5
3	7.07	2.8	5.6	8.5	11.3	14.1	16.9	19.7	22.6	25.4	28.2
4	12.57	5.0	10.0	15.0	20.1	25.1	30.1	35.1	40.1	45.1	50.1
5	19.64	7.8	15.7	23.5	31.3	39.2	47.0	54.8	62.7	70.5	78.3
6	28.27	11.3	22.6	33.8	45.1	56.4	67.7	79.0	90.3	101.5	112.8
7	38.48	15.4	30.7	46.1	61.4	76.8	92.1	107.5	122.8	138.2	153.6
8	50.27	20.1	40.1	60.2	80.2	100.3	120.3	140.4	160.4	180.5	200.6
9	63.62	25.4	50.8	76.2	101.5	126.9	152.3	177.7	203.1	228.5	253.8
10	78.54	31.3	62.7	94.0	125.3	156.7	188.0	219.4	250.7	282.0	313.4
11	95.03	37.9	75.8	113.8	151.7	189.6	227.5	265.4	303.3	341.3	379.2
12	113.10	45.1	90.3	135.4	180.5	225.6	270.8	315.9	361.0	406.1	451.3
13	132.73	53.0	105.9	158.9	211.8	264.8	317.8	370.7	423.7	476.6	529.6
14	153.94	61.4	122.8	184.3	245.7	307.1	368.5	429.9	491.4	552.8	614.2
15	176.72	70.5	141.0	211.5	282.0	352.5	423.1	493.6	564.1	634.6	705.1
16	201.06	80.2	160.4	240.7	320.9	401.1	481.3	561.6	641.8	722.0	802.2
17	226.98	90.6	181.1	271.7	362.3	452.8	543.4	634.0	724.5	815.1	905.7
18	254.47	101.5	203.1	304.6	406.1	507.7	609.2	710.7	812.3	913.8	1015.3
19	283.53	113.1	226.3	339.4	452.5	565.6	678.8	791.9	905.0	1018.2	1131.3
20	314.16	125.3	250.7	376.0	501.4	626.7	752.1	877.4	1002.8	1128.1	1253.5

USAID/AFORP/UMO/Ehrlich, 1985.

Table 3 C. Production of total biomass (dry weight) of Azadirachta indica as a function of DBH.

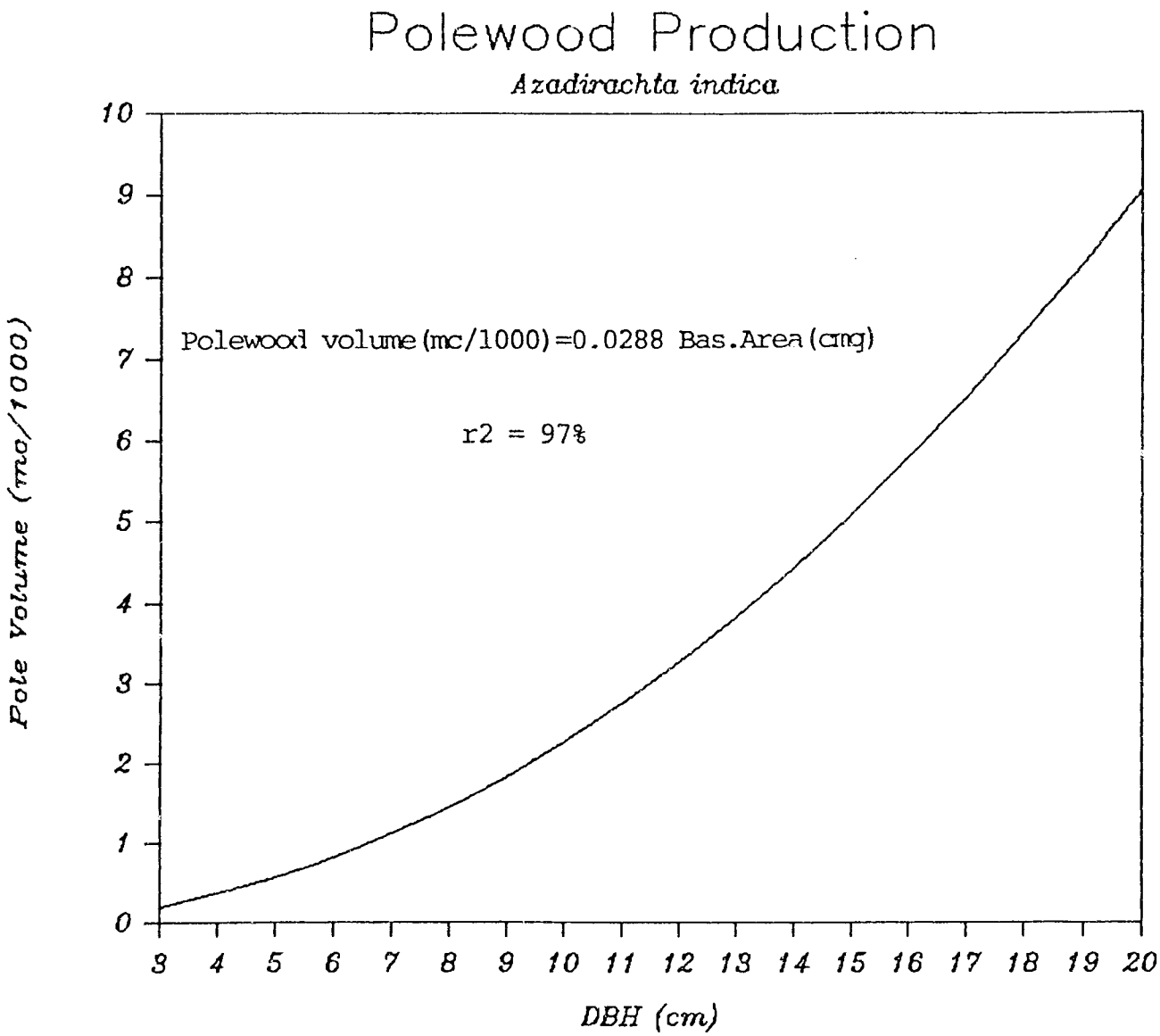

Figure 2 C. Polewood production of Azadirachta indica in Haiti as a function of DBH.

YIELD TABLE

Production of polewood (volume in mc/1000)

as a function of DBH (cm).

Azadirachta indica (Neem) - July 1985.

Polewood volume (mc/1000) = 0.0288 Bas.Area(cmq); r2 = 97%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
3	7.07	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
4	12.57	0.4	0.7	1.1	1.4	1.8	2.2	2.5	2.9	3.3	3.6
5	19.64	0.6	1.1	1.7	2.3	2.8	3.4	4.0	4.5	5.1	5.6
6	28.27	0.8	1.6	2.4	3.3	4.1	4.9	5.7	6.5	7.3	8.1
7	38.48	1.1	2.2	3.3	4.4	5.5	6.6	7.8	8.9	10.0	11.1
8	50.27	1.4	2.9	4.3	5.8	7.2	8.7	10.1	11.6	13.0	14.5
9	63.62	1.8	3.7	5.5	7.3	9.2	11.0	12.8	14.6	16.5	18.3
10	78.54	2.3	4.5	6.8	9.0	11.3	13.6	15.8	18.1	20.3	22.6
11	95.03	2.7	5.5	8.2	10.9	13.7	16.4	19.1	21.9	24.6	27.3
12	113.10	3.3	6.5	9.8	13.0	16.3	19.5	22.8	26.0	29.3	32.5
13	132.73	3.8	7.6	11.5	15.3	19.1	22.9	26.7	30.5	34.4	38.2
14	153.94	4.4	8.9	13.3	17.7	22.1	26.6	31.0	35.4	39.9	44.3
15	176.72	5.1	10.2	15.3	20.3	25.4	30.5	35.6	40.7	45.8	50.8
16	201.06	5.8	11.6	17.4	23.1	28.9	34.7	40.5	46.3	52.1	57.8
17	226.98	6.5	13.1	19.6	26.1	32.7	39.2	45.7	52.2	58.8	65.3
18	254.47	7.3	14.6	22.0	29.3	36.6	43.9	51.2	58.6	65.9	73.2
19	283.53	8.2	16.3	24.5	32.6	40.8	48.9	57.1	65.3	73.4	81.6
20	314.16	9.0	18.1	27.1	36.2	45.2	54.2	63.3	72.3	81.3	90.4

USAID/AFORP/UMO/Ehrlich, 1985.

Table 4 C. Polewood production of Azadirachta indica as a function of DBH.

APPENDIX D

FIGURES AND TABLES
FOR

COLUBRINA ARBORESCENS

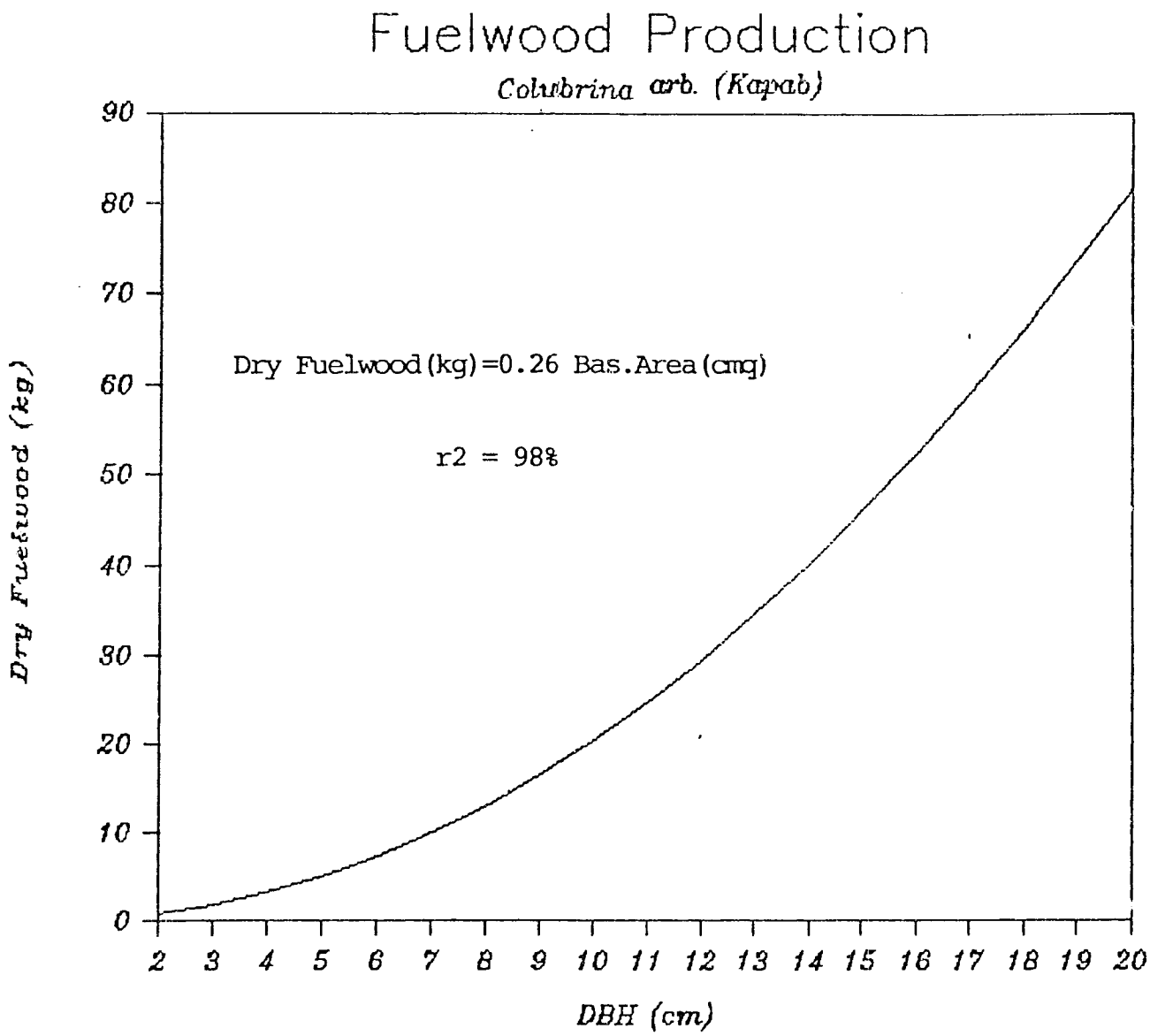

Figure 1 D. Fuelwood production of Colubrina arborescens in Haiti as a function of DBH.

YIELD TABLE
Production of fuelwood (dry weight in kg)
as a function of DBH (cm).
Colubrina arborescens (Kapab) - Aug. 1985.
Dry Fuelwood (kg) = 0.26 Bas.Area (cmq); r2 = 98%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	0.8	1.6	2.5	3.3	4.1	4.9	5.7	6.5	7.4	8.2
3	7.07	1.8	3.7	5.5	7.4	9.2	11.0	12.9	14.7	16.5	18.4
4	12.57	3.3	6.5	9.8	13.1	16.3	19.6	22.9	26.1	29.4	32.7
5	19.64	5.1	10.2	15.3	20.4	25.5	30.6	35.7	40.8	45.9	51.0
6	28.27	7.4	14.7	22.1	29.4	36.8	44.1	51.5	58.8	66.2	73.5
7	38.48	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.1
8	50.27	13.1	26.1	39.2	52.3	65.3	78.4	91.5	104.5	117.6	130.7
9	63.62	16.5	33.1	49.6	66.2	82.7	99.2	115.8	132.3	148.9	165.4
10	78.54	20.4	40.8	61.3	81.7	102.1	122.5	142.9	163.4	183.8	204.2
11	95.03	24.7	49.4	74.1	98.8	123.5	148.2	172.9	197.7	222.4	247.1
12	113.10	29.4	58.8	88.2	117.6	147.0	176.4	205.8	235.2	264.6	294.0
13	132.73	34.5	69.0	103.5	138.0	172.5	207.0	241.5	276.1	310.6	345.1
14	153.94	40.0	80.0	120.1	160.1	200.1	240.1	280.1	320.2	360.2	400.2
15	176.72	45.9	91.9	137.8	183.8	229.7	275.7	321.6	367.5	413.5	459.4
16	201.06	52.3	104.5	156.8	209.1	261.4	313.6	365.9	418.2	470.4	522.7
17	226.98	59.0	118.0	177.0	236.0	295.1	354.1	413.1	472.1	531.1	590.1
18	254.47	66.2	132.3	198.5	264.6	330.8	396.9	463.1	529.3	595.4	661.6
19	283.53	73.7	147.4	221.1	294.8	368.6	442.3	516.0	589.7	663.4	737.1
20	314.16	81.7	163.4	245.0	326.7	408.4	490.1	571.7	653.4	735.1	816.8

USAID/AFORP/UMO/Ehrlich, 1985.

Table 1 D. Fuelwood production (dry weight) of Colubrina arborescens as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of stump diameter (cm).

Colubrina arborescens (Kapab) - Aug. 1985.

Dry Fuelwood (kg)=0.365 Stump sqr.(cmq) + 0.434 Stump (cm); r2 = 97%

Stump (cm)	Stump sqr (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	4	2.3	4.7	7.0	9.3	11.6	14.0	16.3	18.6	21.0	23.3
3	9	4.6	9.2	13.8	18.3	22.9	27.5	32.1	36.7	41.3	45.9
4	16	7.6	15.2	22.7	30.3	37.9	45.5	53.0	60.6	68.2	75.8
5	25	11.3	22.6	33.9	45.2	56.5	67.8	79.1	90.4	101.7	113.0
6	36	15.7	31.5	47.2	63.0	78.7	94.5	110.2	126.0	141.7	157.4
7	49	20.9	41.8	62.8	83.7	104.6	125.5	146.5	167.4	188.3	209.2
8	64	26.8	53.7	80.5	107.3	134.2	161.0	187.8	214.7	241.5	268.3
9	81	33.5	66.9	100.4	133.9	167.4	200.8	234.3	267.8	301.2	334.7
10	100	40.8	81.7	122.5	163.4	204.2	245.0	285.9	326.7	367.6	408.4
11	121	48.9	97.9	146.8	195.8	244.7	293.6	342.6	391.5	440.5	489.4
12	144	57.8	115.5	173.3	231.1	288.8	346.6	404.4	462.1	519.9	577.7
13	169	67.3	134.7	202.0	269.3	336.6	404.0	471.3	538.6	605.9	673.3
14	196	77.6	155.2	232.8	310.5	388.1	465.7	543.3	620.9	698.5	776.2
15	225	88.6	177.3	265.9	354.5	443.2	531.8	620.4	709.1	797.7	886.4
16	256	100.4	200.8	301.2	401.5	501.9	602.3	702.7	803.1	903.5	1003.9
17	289	112.9	225.7	338.6	451.5	564.3	677.2	790.0	902.9	1015.8	1128.6
18	324	126.1	252.1	378.2	504.3	630.4	756.4	882.5	1008.6	1134.6	1260.7
19	361	140.0	280.0	420.0	560.0	700.1	840.1	980.1	1120.1	1260.1	1400.1
20	400	154.7	309.4	464.0	618.7	773.4	928.1	1082.8	1237.4	1392.1	1546.8

USAID/AFORP/UMO/Ehrlich, 1985.

Table 2 D. Fuelwood production (dry weight) of Colubrina arborescens as a function of stump diameter.

YIELD TABLE
Production of total biomass (dry weight in kg)
as a function of DBH (cm).
Colubrina arborescens (Kapab) - Aug. 1985.
Dry Biomass (kg) = 0.318 Bas.Area (cmq); r2 = 98%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
3	7.07	2.2	4.5	6.7	9.0	11.2	13.5	15.7	18.0	20.2	22.5
4	12.57	4.0	8.0	12.0	16.0	20.0	24.0	28.0	32.0	36.0	40.0
5	19.64	6.2	12.5	18.7	25.0	31.2	37.5	43.7	50.0	56.2	62.4
6	28.27	9.0	18.0	27.0	36.0	45.0	53.9	62.9	71.9	80.9	89.9
7	38.48	12.2	24.5	36.7	49.0	61.2	73.4	85.7	97.9	110.1	122.4
8	50.27	16.0	32.0	48.0	63.9	79.9	95.9	111.9	127.9	143.9	159.8
9	63.62	20.2	40.5	60.7	80.9	101.2	121.4	141.6	161.8	182.1	202.3
10	78.54	25.0	50.0	74.9	99.9	124.9	149.9	174.8	199.8	224.8	249.8
11	95.03	30.2	60.4	90.7	120.9	151.1	181.3	211.5	241.8	272.0	302.2
12	113.10	36.0	71.9	107.9	143.9	179.8	215.8	251.8	287.7	323.7	359.7
13	132 73	42.2	84.4	126.6	168.8	211.0	253.3	295.5	337.7	379.9	422.1
14	153.94	49.0	97.9	146.9	195.8	244.8	293.7	342.7	391.6	440.6	489.5
15	176.72	56.2	112.4	168.6	224.8	281.0	337.2	393.4	449.6	505.8	562.0
16	201.06	63.9	127.9	191.8	255.8	319.7	383.6	447.6	511.5	575.4	639.4
17	226.98	72.2	144.4	216.5	288.7	360.9	433.1	505.3	577.4	649.6	721.8
18	254.47	80.9	161.8	242.8	323.7	404.6	485.5	566.4	647.4	728.3	809.2
19	283.53	90.2	180.3	270.5	360.6	450.8	541.0	631.1	721.3	811.5	901.6
20	314.16	99.9	199.8	299.7	399.6	499.5	599.4	699.3	799.2	899.1	999.0

USAID/AFORP/UMO/Ehrlich, 1985.

Table 3 D. Production of total biomass (dry weight) of Colubrina arborescens as a function of DBH.

APPENDIX E

FIGURES AND TABLES

FOR

EUCALYPTUS CAMADULENSIS

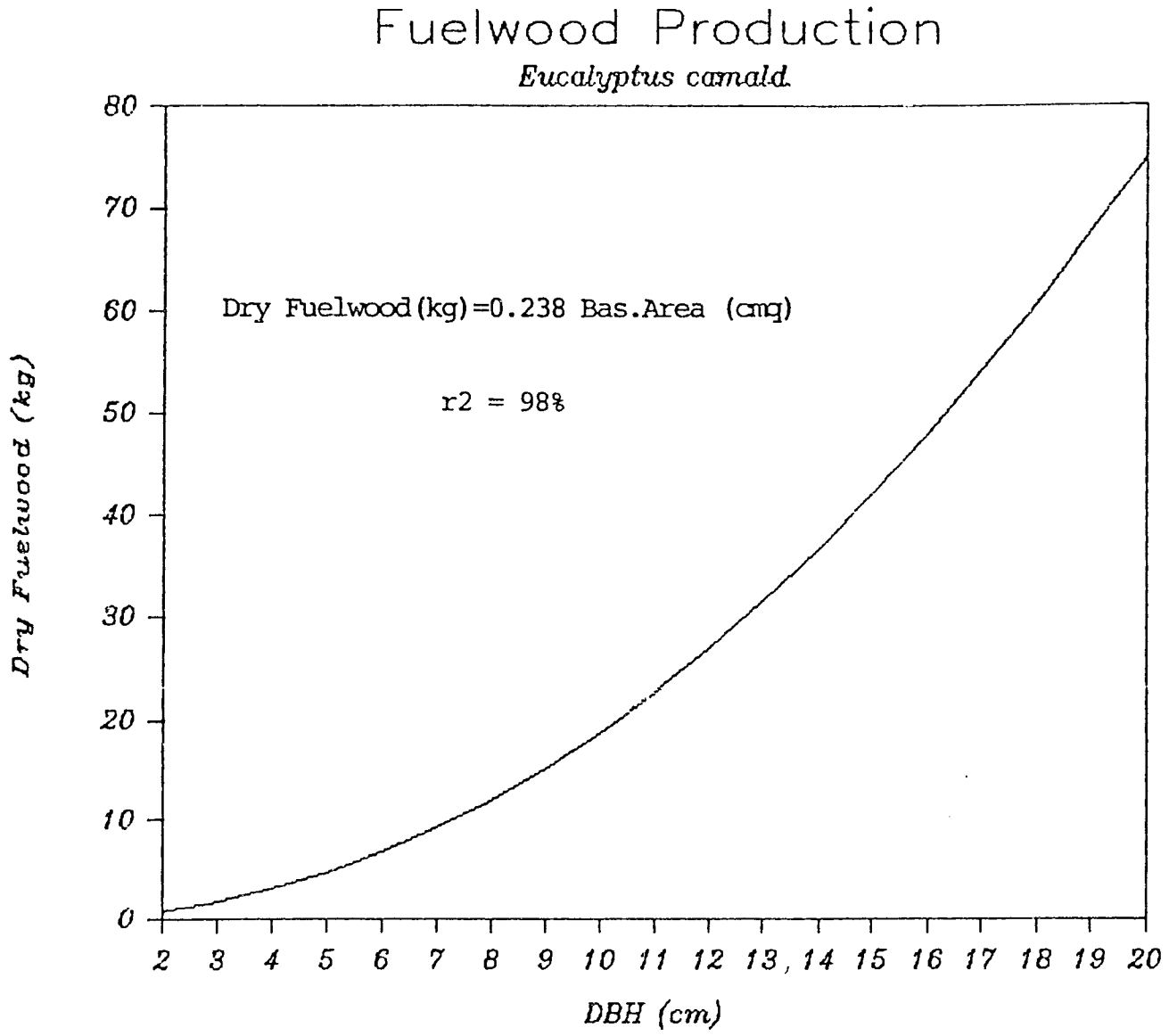

Figure 1 E. Fuelwood production of Eucalyptus camadulensis as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of DBH (cm).

Eucalyptus camaldulensis - Aug. 1985.

Dry Fuelwood (kg)=0.238 Bas.Area (cmq); r2 = 98%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	0.7	1.5	2.2	3.0	3.7	4.5	5.2	6.0	6.7	7.5
3	7.07	1.7	3.4	5.1	6.7	8.4	10.1	11.8	13.5	15.2	16.9
4	12.57	3.0	6.0	9.0	12.0	15.0	18.0	21.0	24.0	27.0	30.0
5	19.64	4.7	9.4	14.0	18.7	23.4	28.1	32.8	37.5	42.1	46.8
6	28.27	6.7	13.5	20.2	27.0	33.7	40.4	47.2	53.9	60.7	67.4
7	38.48	9.2	18.4	27.5	36.7	45.9	55.1	64.2	73.4	82.6	91.8
8	50.27	12.0	24.0	36.0	47.9	59.9	71.9	83.9	95.9	107.9	119.8
9	63.62	15.2	30.3	45.5	60.7	75.8	91.0	106.2	121.3	136.5	151.7
10	78.54	18.7	37.5	56.2	74.9	93.6	112.4	131.1	149.8	168.5	187.3
11	95.03	22.7	45.3	68.0	90.6	113.3	135.9	158.6	181.3	203.9	226.6
12	113.10	27.0	53.9	80.9	107.9	134.8	161.8	188.8	215.7	242.7	269.6
13	132.73	31.6	63.3	94.9	126.6	158.2	189.9	221.5	253.2	284.8	316.5
14	153.94	36.7	73.4	110.1	146.8	183.5	220.2	256.9	293.6	330.3	367.0
15	176.72	42.1	84.3	126.4	168.5	210.7	252.8	294.9	337.1	379.2	421.3
16	201.06	47.9	95.9	143.8	191.7	239.7	287.6	335.6	383.5	431.4	479.4
17	226.98	54.1	108.2	162.4	216.5	270.6	324.7	378.8	432.9	487.1	541.2
18	254.47	60.7	121.3	182.0	242.7	303.4	364.0	424.7	485.4	546.0	606.7
19	283.53	67.6	135.2	202.8	270.4	338.0	405.6	473.2	540.8	608.4	676.0
20	314.16	74.9	149.8	224.7	299.6	374.5	449.4	524.3	599.2	674.1	749.0

USAID/AFORP/UMO/Ehrlich, 1985.

Table 1 E. Fuelwood production (dry weight) of Eucalyptus camaldulensis as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of stump diameter (cm).

Eucalyptus camaldulensis - Aug. 1985.

Dry Fuelwood (kg)= 2.205 (stump) - 1.132 sqr.root (stump); r2 = 91%

Stump (cm)	sqr.root Stump	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	1.41	2.8	5.6	8.4	11.2	14.0	16.8	19.7	22.5	25.3	28.1
3	1.73	4.7	9.3	14.0	18.6	23.3	27.9	32.6	37.2	41.9	46.5
4	2.00	6.6	13.1	19.7	26.2	32.8	39.3	45.9	52.4	59.0	65.5
5	2.24	8.5	17.0	25.5	34.0	42.5	50.9	59.4	67.9	76.4	84.9
6	2.45	10.5	20.9	31.4	41.8	52.3	62.7	73.2	83.6	94.1	104.5
7	2.65	12.4	24.9	37.3	49.7	62.2	74.6	87.1	99.5	111.9	124.4
8	2.83	14.4	28.9	43.3	57.7	72.2	86.6	101.0	115.5	129.9	144.3
9	3.00	16.4	32.9	49.3	65.8	82.2	98.7	115.1	131.6	148.0	164.4
10	3.16	18.5	36.9	55.4	73.9	92.3	110.8	129.3	147.7	166.2	184.7
11	3.32	20.5	41.0	61.5	82.0	102.5	123.0	143.5	164.0	184.5	205.0
12	3.46	22.5	45.1	67.6	90.1	112.7	135.2	157.7	180.3	202.8	225.3
13	3.61	24.6	49.2	73.7	98.3	122.9	147.5	172.0	196.6	221.2	245.8
14	3.74	26.6	53.3	79.9	106.5	133.1	159.8	186.4	213.0	239.6	266.3
15	3.87	28.7	57.4	86.1	114.7	143.4	172.1	200.8	229.5	258.2	286.8
16	4.00	30.7	61.5	92.2	123.0	153.7	184.5	215.2	246.0	276.7	307.4
17	4.12	32.8	65.6	98.4	131.2	164.0	196.9	229.7	262.5	295.3	328.1
18	4.24	34.9	69.8	104.6	139.5	174.4	209.3	244.2	279.0	313.9	348.8
19	4.36	37.0	73.9	110.9	147.8	184.8	221.7	258.7	295.6	332.6	369.5
20	4.47	39.0	78.1	117.1	156.1	195.1	234.2	273.2	312.2	351.3	390.3

USAID/AFORP/UMO/Ehrlich, 1985.

Table 2 E. Fuelwood production (dry weight) of Eucalyptus camaldulensis as a function of stump diameter.

YIELD TABLE

Production of total biomass (dry weight in kg)
as a function of DBH (cm).
Eucalyptus camaldulensis - Aug. 1985.
Dry Biomass (kg) = 0.32 Bas.Area (cmq); r2 = 99%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
3	7.07	2.3	4.5	6.8	9.0	11.3	13.6	15.8	18.1	20.3	22.6
4	12.57	4.0	8.0	12.0	16.1	20.1	24.1	28.1	32.1	36.1	40.2
5	19.64	6.3	12.6	18.8	25.1	31.4	37.7	43.9	50.2	56.5	62.8
6	28.27	9.0	18.1	27.1	36.1	45.2	54.2	63.3	72.3	81.3	90.4
7	38.48	12.3	24.6	36.9	49.2	61.5	73.8	86.1	98.4	110.7	123.0
8	50.27	16.1	32.1	48.2	64.3	80.3	96.4	112.5	128.5	144.6	160.7
9	63.62	20.3	40.7	61.0	81.3	101.7	122.0	142.3	162.7	183.0	203.3
10	78.54	25.1	50.2	75.3	100.4	125.5	150.6	175.7	200.8	225.9	251.0
11	95.03	30.4	60.7	91.1	121.5	151.9	182.2	212.6	243.0	273.4	303.7
12	113.10	36.1	72.3	108.4	144.6	180.7	216.9	253.0	289.2	325.3	361.5
13	132.73	42.4	84.8	127.3	169.7	212.1	254.5	297.0	339.4	381.8	424.2
14	153.94	49.2	98.4	147.6	196.8	246.0	295.2	344.4	393.6	442.8	492.0
15	176.72	56.5	113.0	169.4	225.9	282.4	338.9	395.4	451.9	508.3	564.8
16	201.06	64.3	128.5	192.8	257.1	321.3	385.6	449.8	514.1	578.4	642.6
17	226.98	72.5	145.1	217.6	290.2	362.7	435.3	507.8	580.4	652.9	725.5
18	254.47	81.3	162.7	244.0	325.3	406.7	488.0	569.3	650.7	732.0	813.3
19	283.53	90.6	181.2	271.9	362.5	453.1	543.7	634.4	725.0	815.6	906.2
20	314.16	100.4	200.8	301.2	401.6	502.1	602.5	702.9	803.3	903.7	1004.1

USAID/AFORP/UMO/Ehrlich, 1985.

Table 3 E. Production of total biomass (dry weight) of Eucalyptus camadulensis as a function of DBH.

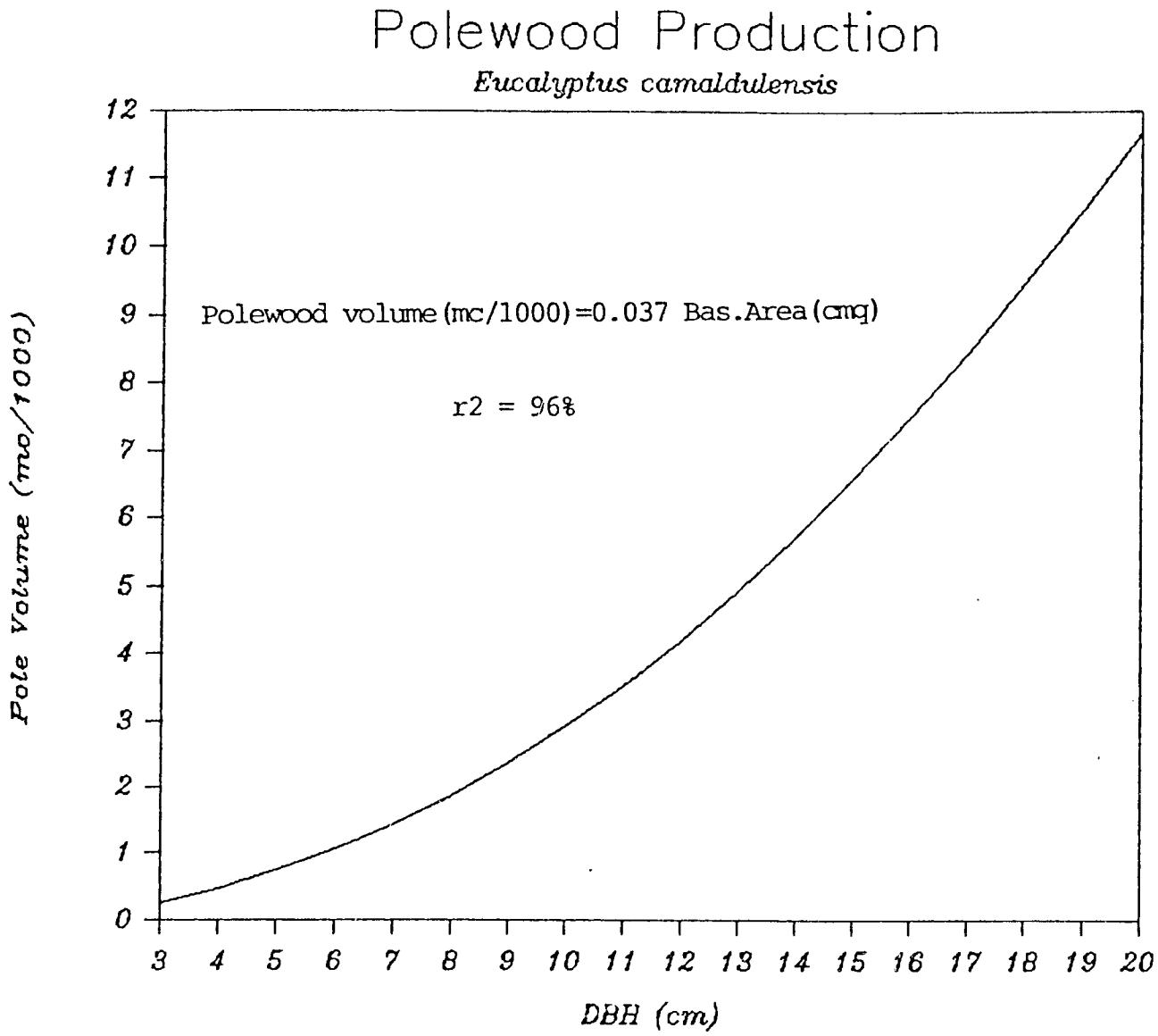

Figure 2 E. Polewood production of Eucalyptus camaldulensis in Haiti as a function of DBH.

YIELD TABLE

Production of polewood (volume in mc/1000)

as a function of DBH (cm).

Eucalyptus camaldulensis - July 1985.

Polewood volume (mc/1000) = 0.037 Bas.Area(cmq); r2 = 96%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
3	7.07	0.3	0.5	0.8	1.1	1.3	1.6	1.8	2.1	2.4	2.6
4	12.57	0.5	0.9	1.4	1.9	2.3	2.8	3.3	3.7	4.2	4.7
5	19.64	0.7	1.5	2.2	2.9	3.6	4.4	5.1	5.8	6.6	7.3
6	28.27	1.1	2.1	3.2	4.2	5.3	6.3	7.4	8.4	9.5	10.5
7	38.48	1.4	2.9	4.3	5.7	7.1	8.6	10.0	11.4	12.9	14.3
8	50.27	1.9	3.7	5.6	7.5	9.3	11.2	13.1	14.9	16.8	18.7
9	63.62	2.4	4.7	7.1	9.5	11.8	14.2	16.5	18.9	21.3	23.6
10	78.54	2.9	5.8	8.8	11.7	14.6	17.5	20.4	23.3	26.3	29.2
11	95.03	3.5	7.1	10.6	14.1	17.7	21.2	24.7	28.2	31.8	35.3
12	113.10	4.2	8.4	12.6	16.8	21.0	25.2	29.4	33.6	37.8	42.0
13	132.73	4.9	9.9	14.8	19.7	24.7	29.6	34.5	39.4	44.4	49.3
14	153.94	5.7	11.4	17.2	22.9	28.6	34.3	40.0	45.8	51.5	57.2
15	176.72	6.6	13.1	19.7	26.3	32.8	39.4	46.0	52.5	59.1	65.6
16	201.06	7.5	14.9	22.4	29.9	37.3	44.8	52.3	59.8	67.2	74.7
17	226.98	8.4	16.9	25.3	33.7	42.2	50.6	59.0	67.5	75.9	84.3
18	254.47	9.5	18.9	28.4	37.8	47.3	56.7	66.2	75.6	85.1	94.5
19	283.53	10.5	21.1	31.6	42.1	52.7	63.2	73.7	84.3	94.8	105.3
20	314.16	11.7	23.3	35.0	46.7	58.4	70.0	81.7	93.4	105.0	116.7

USAID/AFORP/UMO/Ehrlich, 1985.

Table 4 E. Polewood production of Eucalyptus camaldulensis as a function of DBH.

APPENDIX F

FIGURES AND TABLES

FOR

PROSOPIS JULIFLORA

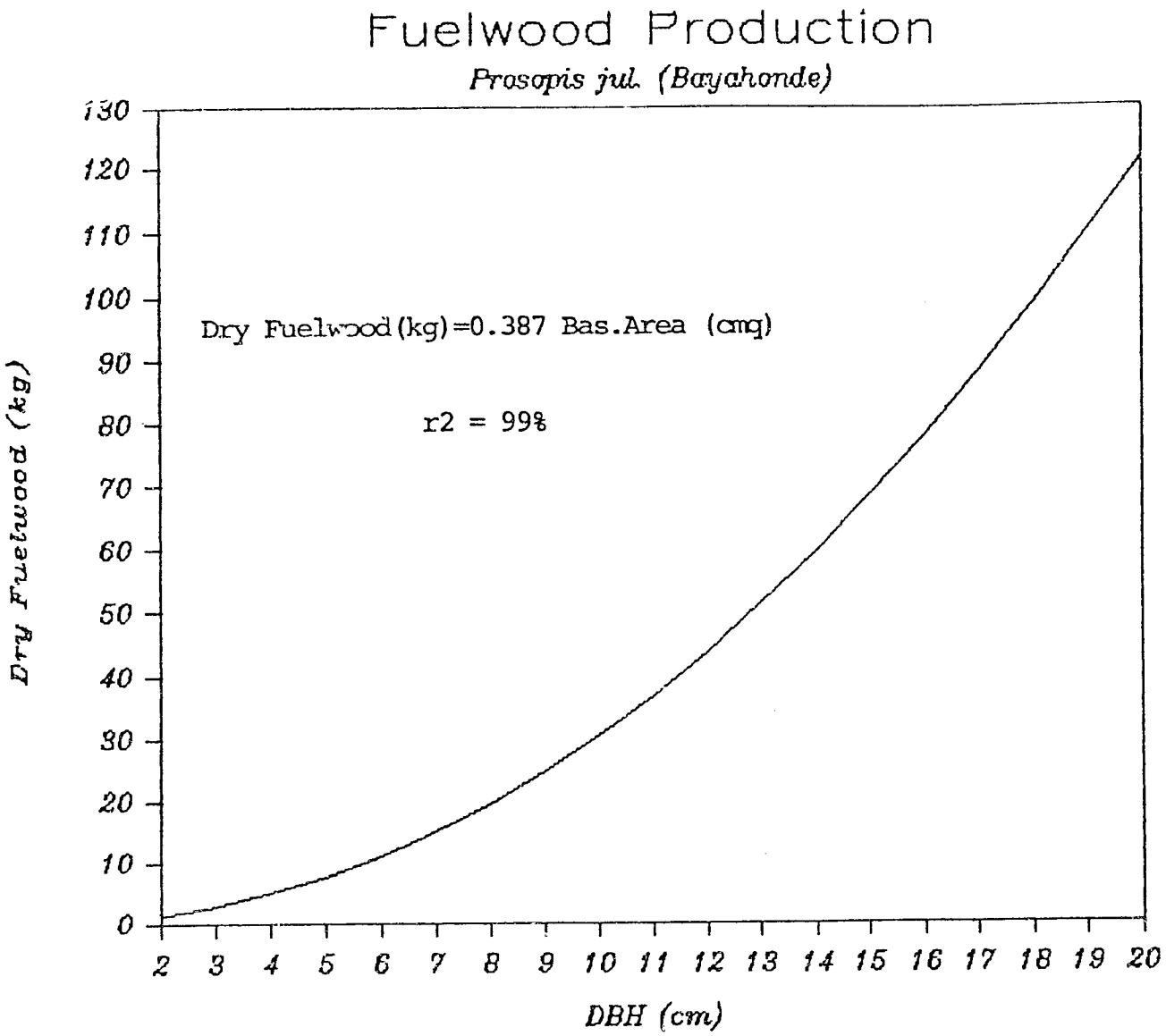

Figure 1 F. Fuelwood production (dry weight) of Prosopis juliflora as a function of DBH.

YIELD TABLE
Production of fuelwood (dry weight in kg)
as a function of DBH (cm).
Prosopis juliflora (Bayahonde) - Aug. 1985.
Dry Fuelwood (kg)=0.387 Bas.Area (cmq); r2 = 99%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	1.2	2.4	3.6	4.9	6.1	7.3	8.5	9.7	10.9	12.1
3	7.07	2.7	5.5	8.2	10.9	13.7	16.4	19.1	21.9	24.6	27.3
4	12.57	4.9	9.7	14.6	19.4	24.3	29.1	34.0	38.9	43.7	48.6
5	19.64	7.6	15.2	22.8	30.4	38.0	45.5	53.1	60.7	68.3	75.9
6	28.27	10.9	21.9	32.8	43.7	54.7	65.6	76.5	87.4	98.4	109.3
7	38.48	14.9	29.8	44.6	59.5	74.4	89.3	104.1	119.0	133.9	148.8
8	50.27	19.4	38.9	58.3	77.7	97.2	116.6	136.0	155.5	174.9	194.3
9	63.62	24.6	49.2	73.8	98.4	123.0	147.6	172.2	196.8	221.4	246.0
10	78.54	30.4	60.7	91.1	121.5	151.8	182.2	212.6	242.9	273.3	303.6
11	95.03	36.7	73.5	110.2	147.0	183.7	220.4	257.2	293.9	330.7	367.4
12	113.10	43.7	87.4	131.2	174.9	218.6	262.3	306.1	349.8	393.5	437.2
13	132.73	51.3	102.6	153.9	205.3	256.6	307.9	359.2	410.5	461.8	513.2
14	153.94	59.5	119.0	178.5	238.1	297.6	357.1	416.6	476.1	535.6	595.1
15	176.72	68.3	136.6	205.0	273.3	341.6	409.9	478.2	546.6	614.9	683.2
16	201.06	77.7	155.5	233.2	310.9	388.7	466.4	544.1	621.9	699.6	777.3
17	226.98	87.8	175.5	263.3	351.0	438.8	526.5	614.3	702.0	789.8	877.5
18	254.47	98.4	196.8	295.1	393.5	491.9	590.3	688.7	787.0	885.4	983.8
19	283.53	109.6	219.2	328.8	438.5	548.1	657.7	767.3	876.9	986.5	1096.2
20	314.16	121.5	242.9	364.4	485.8	607.3	728.7	850.2	971.7	1093.1	1214.6

USAID/AFORP/UMO/Ehrlich, 1985.

Table 1 F. Fuelwood production (dry weight) of Prosopis juliflora as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of stump diameter (cm).

Prosopis juliflora (Bayahonde) - Sept. 1985.

Dry Fuelwood (kg)=0.195 Stump diam. sqr.(cmq); r2 = 97%

Stump (cm)	Stump sqr (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	4	0.8	1.6	2.3	3.1	3.9	4.7	5.5	6.3	7.0	7.8
3	9	1.8	3.5	5.3	7.0	8.8	10.5	12.3	14.1	15.8	17.6
4	16	3.1	6.3	9.4	12.5	15.6	18.8	21.9	25.0	28.1	31.3
5	25	4.9	9.8	14.6	19.5	24.4	29.3	34.2	39.1	43.9	48.8
6	36	7.0	14.1	21.1	28.1	35.2	42.2	49.2	56.3	63.3	70.3
7	49	9.6	19.1	28.7	38.3	47.9	57.4	67.0	76.6	86.1	95.7
8	64	12.5	25.0	37.5	50.0	62.5	75.0	87.5	100.0	112.5	125.0
9	81	15.8	31.6	47.5	63.3	79.1	94.9	110.8	126.6	142.4	158.2
10	100	19.5	39.1	58.6	78.1	97.7	117.2	136.7	156.3	175.8	195.3
11	121	23.6	47.3	70.9	94.5	118.2	141.8	165.4	189.1	212.7	236.3
12	144	28.1	56.3	84.4	112.5	140.6	168.8	196.9	225.0	253.1	281.3
13	169	33.0	66.0	99.0	132.0	165.1	198.1	231.1	264.1	297.1	330.1
14	196	38.3	76.6	114.9	153.1	191.4	229.7	268.0	306.3	344.6	382.8
15	225	43.9	87.9	131.8	175.8	219.7	263.7	307.6	351.6	395.5	439.5
16	256	50.0	100.0	150.0	200.0	250.0	300.0	350.0	400.0	450.0	500.0
17	289	56.5	112.9	169.4	225.8	282.3	338.7	395.2	451.6	508.1	564.5
18	324	63.3	126.6	189.9	253.1	316.4	379.7	443.0	506.3	569.6	632.9
19	361	70.5	141.0	211.5	282.1	352.6	423.1	493.6	564.1	634.6	705.1
20	400	78.1	156.3	234.4	312.5	390.7	468.8	546.9	625.1	703.2	781.3

USAID/AFORP/UMO/Ehrlich, 1985.

Table 2 F. Fuelwood production (dry weight) of Prosopis juliflora as a function of stump diameter.

YIELD TABLE

Production of total biomass (dry weight in kg)
as a function of DBH (cm).
Prosopis juliflora (Bayahonde) - Sept.1985
Dry Biomass (kg) = 0.52 Bas.Area (cmq); r2 = 97%

DBH (cm)	Bas.Area (cmq)	NUMBER OF TREES 1	2	3	4	5	6	7	8	9	10
2	3.14	1.6	3.3	4.9	6.5	8.2	9.8	11.4	13.1	14.7	16.3
3	7.07	3.7	7.3	11.0	14.7	18.4	22.0	25.7	29.4	33.0	36.7
4	12.57	6.5	13.1	19.6	26.1	32.6	39.2	45.7	52.2	58.7	65.3
5	19.64	10.2	20.4	30.6	40.8	51.0	61.2	71.4	81.6	91.8	102.0
6	28.27	14.7	29.4	44.1	58.7	73.4	88.1	102.8	117.5	132.2	146.9
7	38.48	20.0	40.0	60.0	80.0	99.9	119.9	139.9	159.9	179.9	199.9
8	50.27	26.1	52.2	78.3	104.4	130.5	156.6	182.8	208.9	235.0	261.1
9	63.62	33.0	66.1	99.1	132.2	165.2	198.3	231.3	264.3	297.4	330.4
10	78.54	40.8	81.6	122.4	163.2	204.0	244.8	285.6	326.3	367.1	407.9
11	95.03	49.4	98.7	148.1	197.4	246.8	296.2	345.5	394.9	444.2	493.6
12	113.10	58.7	117.5	176.2	235.0	293.7	352.5	411.2	469.9	528.7	587.4
13	132.73	68.9	137.9	206.8	275.8	344.7	413.6	482.6	551.5	620.5	689.4
14	153.94	80.0	159.9	239.9	319.8	399.8	479.7	559.7	639.6	719.6	799.6
15	176.72	91.8	183.6	275.4	367.1	458.9	550.7	642.5	734.3	826.1	917.9
16	201.06	104.4	208.9	313.3	417.7	522.2	626.6	731.0	835.5	939.9	1044.3
17	226.98	117.9	235.8	353.7	471.6	589.5	707.4	825.3	943.1	1061.0	1178.9
18	254.47	132.2	264.3	396.5	528.7	660.9	793.0	925.2	1057.4	1189.5	1321.7
19	283.53	147.3	294.5	441.8	589.1	736.3	883.6	1030.9	1178.1	1325.4	1472.7
20	314.16	163.2	326.3	489.5	652.7	815.9	979.0	1142.2	1305.4	1468.6	1631.7

USAID/AFORP/UMO/Ehrlich, 1985.

Table 3 F. Production of total biomass (dry weight) of Prosopis juliflora as a function of DBH.

APPENDIX G

FIGURES AND TABLES

FOR

SUMMARY

OF

ALL SPECIES

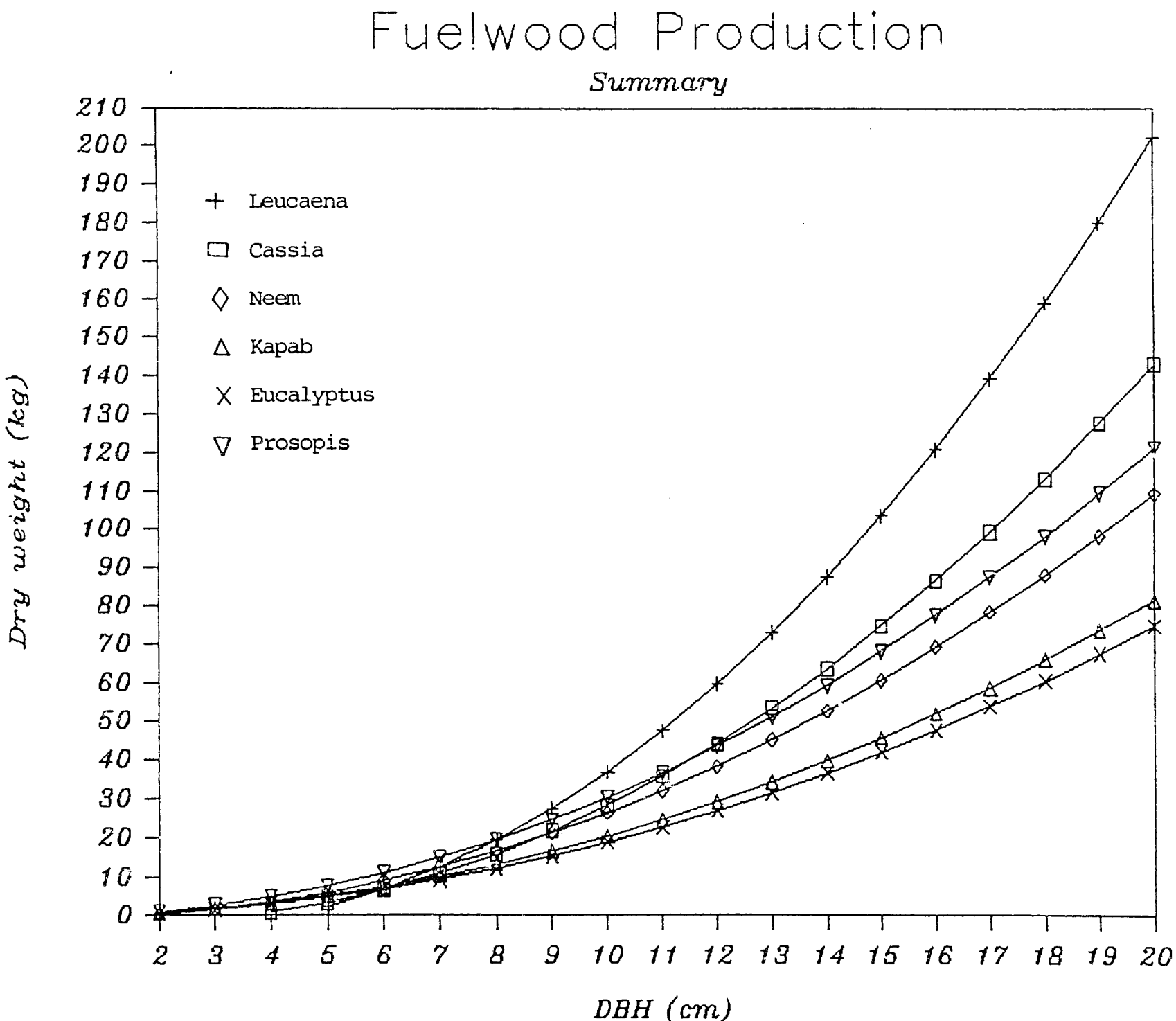

Figure 1 G. Fuelwood production for six species in Haiti as a function of DBH.

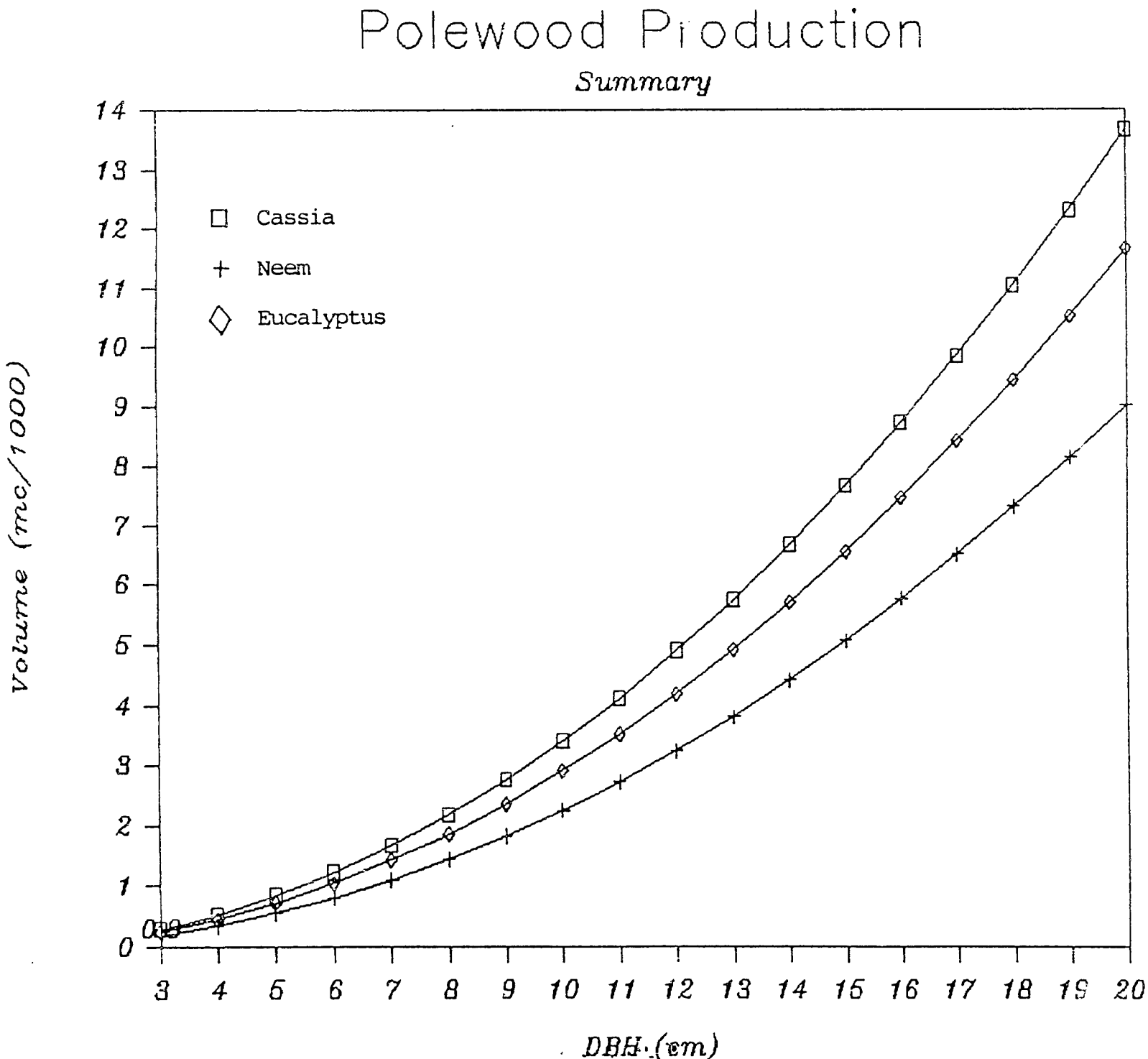

Figure 2 G. Polewood production of three species in Haiti as a function of DBH.

YIELD TABLE

Production of fuelwood (dry weight in kg)

as a function of DBH (cm).

Summary results for all species (July-Aug.1985)

DBH (cm)	Bas.Area (cmq)	TREE SPECIES Cassia	Leucaena	Neem	Kapab	Eucalypt	Prosopis
2	3.14			0.4	0.8	0.7	1.2
3	7.07			1.7	1.8	1.7	2.7
4	12.57	0.9		3.5	3.3	3.0	4.9
5	19.64	3.3	2.5	5.9	5.1	4.7	7.6
6	28.27	6.6	6.9	8.9	7.4	6.7	10.9
7	38.48	10.7	12.5	12.4	10.0	9.2	14.9
8	50.27	15.7	19.4	16.5	13.1	12.0	19.4
9	63.62	21.6	27.6	21.1	16.5	15.2	24.6
10	78.54	28.3	37.1	26.3	20.4	18.7	30.4
11	95.03	35.9	47.9	32.1	24.7	22.7	36.7
12	113.10	44.3	59.9	38.5	29.4	27.0	43.7
13	132.73	53.6	73.3	45.4	34.5	31.6	51.3
14	153.94	63.8	87.9	52.8	40.0	36.7	59.5
15	176.72	74.9	103.8	60.9	45.9	42.1	68.3
16	201.06	86.8	121.0	69.5	52.3	47.9	77.7
17	226.98	99.6	139.4	78.6	59.0	54.1	87.8
18	254.47	113.2	159.2	88.4	66.2	60.7	98.4
19	283.53	127.7	180.2	98.6	73.7	67.6	109.6
20	314.16	143.1	202.5	109.5	81.7	74.9	121.5
21	346.36	159.3	226.1				
22	380.13	176.5	251.0				
23	415.48	194.4	277.2				

USAID/AFORP/UMO/Ehrlich, 1985.

Table 1 G. Fuelwood production (dry weight) for all species as a function of DBH.

YIELD TABLE

Production of polewood (cubic meters/1000)
as a function of DBH (cm).
Summary results for all species (July-Aug.1985)

DBH (cm)	Bas.Area (cmq)	TREE SPECIES Cassia	Neem	Eucalyptus
3	7.07	0.3	0.2	0.3
4	12.57	0.5	0.4	0.5
5	19.64	0.9	0.6	0.7
6	28.27	1.2	0.8	1.1
7	38.48	1.7	1.1	1.4
8	50.27	2.2	1.4	1.9
9	63.62	2.8	1.8	2.4
10	78.54	3.4	2.3	2.9
11	95.03	4.1	2.7	3.5
12	113.10	4.9	3.3	4.2
13	132.73	5.8	3.8	4.9
14	153.94	6.7	4.4	5.7
15	176.72	7.7	5.1	6.6
16	201.06	8.7	5.8	7.5
17	226.98	9.9	6.5	8.4
18	254.47	11.1	7.3	9.5
19	283.53	12.3	8.2	10.5
20	314.16	13.7	9.0	11.7

USAID/AFORP/UMO/Ehrlich, 1985.

Table 2 G. Polewood production for all species as a function of DBH.