

# USES, MANAGEMENT, AND ECONOMIC POTENTIAL OF *DACRYODES EDULIS* (BURSERACEAE) IN THE HUMID LOWLANDS OF CAMEROON<sup>1</sup>

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*DACRYODES EDULIS* EST L'UNE DES ESPÈCES PRÉFÉRÉES PAR LES PAYSANS DES BASSES TERRES HUMIDES DU CAMEROUN. Les fruits font l'objet d'un commerce inter-frontalier entre le Cameroun, le Gabon et le Nigeria. Bien que les données sur ce commerce soient disponibles, il manque de données à l'échelle de l'exploitation paysanne. Une enquête a été menée pour identifier l'utilisation de produits de l'espèce, son mode de gestion et les caractéristiques que les paysans aimeraient voir améliorer. L'autre objectif de l'enquête consistait à quantifier, au niveau des paysans, le potentiel économique de l'espèce. Les résultats de l'enquête montrent que les plants issus de semis constituent le mode de propagation le plus utilisé pour la reproduction du *D. edulis* et que l'espèce se trouve principalement dans les cacaoyers, cafeiers et jardins de case. Les fruits sont largement consommés et vendus. La valeur annuelle de la production de fruit atteint \$US161 par producteur ou collecteur. Les branches mortes sont utilisées comme bois de chauffe et l'écorce est utilisée en pharmacopée traditionnelle. Parmi les axes de recherche sur l'amélioration de l'espèce souhaités par les paysans on note l'augmentation de la taille du fruit, l'amélioration du goût, l'augmentation de la production annuelle et la réduction du temps à la fructification.

**Key Words:** humid lowlands of Cameroon; non-timber forest products; *Dacryodes edulis*; improvement objectives; farm-level; economic potential.

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The humid lowlands of Cameroon are dominated by extensive tropical rain forests which

are known to be among the richest flora on earth. Apart from their crucial role in maintaining and enhancing environmental quality, they are also a reservoir of enormous quantity of animal and plant species that are vital for human existence and constitute an integral part of rural econo-

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mies. Local communities depend heavily on these forest species as a source of important non-timber forest products (NTFP), including food, condiment, medicine and raw materials for various uses (Duguma, Tonye, and Depommier 1990).

In the future NTFP, will become of even greater economic importance for a number of reasons. First, demographic pressures on land resources have accentuated the need to explore non-conventional sources of food to meet the needs of the rising population. Second, owing to population pressure, fallow periods have declined from over 10 years to less than 5 years – 1 to 3 years in most places—(Duguma, Tonye and Depommier 1990) rendering the system economically inefficient and environmentally/ecologically unsustainable. Third, forest products provide opportunities for earning cash and consequently achieving the goal of income diversification as a strategy to minimize risks associated with conventional farming practices, such as low and fluctuating cash crop prices. Many products from the tropical rain forest are currently being traded on regional and international markets and can play an essential role in earning badly needed foreign exchange.

The degree to which NTFP can meet the needs of land-users depends largely on how forest trees can be domesticated and integrated into the land use system. Domestication is a dynamic process that develops from choosing the species to be domesticated, through background socio-economic studies, to the actual germplasm collections and genetic improvement (Leakey and Jaenicke 1995). Efforts to introduce forest trees into the land use system should rely on: (1) a better understanding of farmers' indigenous knowledge of their ecosystem; (2) farmers' intended uses of trees—preferred products and services—and the way trees are integrated in their land use system; and (3) the introduction of appropriate plant material.

Previous research has reported on the type of products and species from which various NTFP in the ecozone are harvested (Falconer 1992; FAO 1981; Okafor and Fernandes 1987; World Resource Institute 1985). Another study investigating performance of NTFPs in the humid lowlands of Cameroon reported that about 587 tons of *D. edulis* fruits were traded in the region during the period January to July 1995 for a value of \$US 244 000 (CIFOR 1996). Species pref-

erence surveys found that *D. edulis* was the third most preferred tree species in the humid lowlands of Cameroon and was widely preferred in Southern Nigeria and Gabon as well (Adeola et al. 1998; Boland et al. 1995; Mollet et al. 1995). However, empirical data on the relative economic importance of NTFP are not available at the farm-level.

The objective of this paper is to assess, at the farm-level, the uses, management and economic value of *D. edulis* (G. Don) HJ LAM in the humid lowlands of Cameroon. Detailed quantification of the monetary value of commonly used NTFPs is essential in identifying key products and species that can improve the welfare of local communities. This kind of information can be useful in identifying ways to improve the production and marketability of key species.

## DESCRIPTION OF SPECIES

### *DACRYODES EDULIS* (G. DON) HJ LAM (AFRICAN PEAR OR AFRICAN PLUM)

*Dacryodes edulis* is an oliferous fruit tree found in equatorial and humid tropic climates and originates from Central Africa and Gulf of Guinea area (Auberville 1962). Its actual geographical area spreads from nearly all over the western coast of Africa across to Uganda. Because it can be easily planted, *D. edulis* is found in many parts of Cameroon. Around the homestead or village the tree is between 8 and 10 m in height. In the forest it reaches 20 m with a crown diameter of 150 cm.

The mesocarp is the edible part of the fruit with a pulp rich in fatty acids, amino acids, and vitamins (Umoru and Okayi 1987; Achinewu 1983; Silou 1991). The fruits are of very high cash value because they are sold very widely in Cameroon and in most countries of Central Africa (Leakey and Ladipo 1996). The oil can be used in cosmetic and food industries. The tree is also used as medicine and dead branches as firewood. *D. edulis* trees on farms provide shade for food and tree crops and for humans (Adeola et al. 1998; Mollet et al. 1995).

Multiplication by seed results in extremely heterogenous populations. Because of the low vitality of its vegetative organs, *D. edulis* is a recalcitrant species to vegetative propagation (Philippe 1957). Recent research (Kengue 1990; Kengue and Tchio 1994) has also reported 80% success on aerial layering.

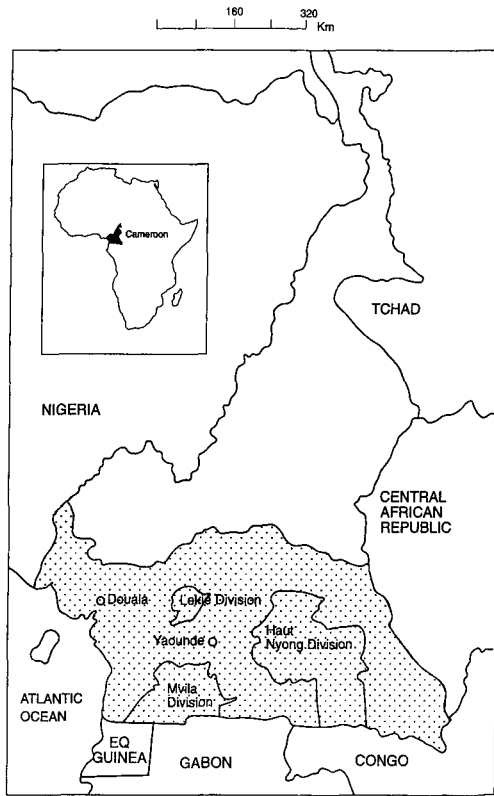


Fig. 1. Study sites in the humid lowlands of Cameroon with elevation less than 1000 m a.s.l.

## METHODS

### STUDY SITE

The humid lowlands are defined as areas below 1000 m altitude with an annual precipitation of above 1500 mm, a growing period of 270–365 days and covered by tropical moist forest vegetation. In Cameroon, the humid lowlands are divided into 2 zones: the coastal lines with an altitude of 0 m to 300 m and the continental plateau with an altitude ranging between 600 and 800 m above sea level (Tonye et al. 1986). The area delimiting the humid lowlands in Cameroon together with the study sites are shown in Fig. 1.

The principal land use system in the study site is based on cocoa and coffee. However, there is a marked variation in four variables which greatly influence the quantity and types of NTFP that people collect: market accessibility, population density, ethnic groups and infrastructure. These variables were used to classify the priority land use system into three strata from which three administrative units (divisions) were randomly selected (Table 1). The three strata corresponded to areas of low, medium and high market accessibility. For low market accessibility area Haut Nyong division (East Province) was chosen, for medium accessibility Mvila division (South Province) and for high accessibility Lekié division (Centre Province.)

Haut Nyong division is located between latitude 2°0'N and 4°30'N and longitude 12°30'E and 14°40'E. The mean monthly temperature is 22.5°C. The division is not easily accessible to urban markets. Population density is low (4 inhabitant/km<sup>2</sup>) and infrastructure is poor. The Makas constitute the major ethnic group.

Mvila is located between latitude 2°22'N and 2°29'N and longitude 10°17'E and 12°14'E. The division shares boundaries with Equatorial Guinea and the Republic of Gabon. The mean monthly temperature is 24°C. Market accessibility is moderate in this division and there is modest infrastructure. The population density is medium (10 inhabitants/km<sup>2</sup>) and the dominant ethnic group is the Bulu.

The Lekié division is situated between latitude 3°50'N and 4°30'N and longitude 11°0'E and 12°0'E. Mean monthly temperature of the division is 25°C. This is a highly populated area (25 inhabitants/km<sup>2</sup>) with good infrastructure and easily accessible to urban markets. The Etons are the major ethnic group in the division.

In all three divisions, the rainfall pattern is bimodal, with two rainy seasons occurring during mid-March to mid-July and mid-August to mid-November. Mean annual rainfall ranges from 1650 mm in Haut Nyong to 1860 mm in

TABLE 1. VARIABLES USED TO STRATIFY THE STUDY AREA.

Market accessibility	Ethnic group	Population density	Division
Low	Maka, Bama, Pygmies	Low	Haut Nyong
Medium, export area but poor infrastructure	Bulu	Medium	Mvila
High, good infrastructure	Eton	High	Lekié

Mvila. During the rest of the months, referred to as main (mid-November to mid-March) and minor (mid-July to mid-August) dry seasons, total monthly rainfall hardly exceeds 50 mm.

In Haut Nyong and Mvila, both secondary and primary rain forests are still available. The vegetation is essentially evergreen rain forest with mosaic of raffia swamps near rivers and logging areas. Dominant tree species include *Albizia* sp., *Ficus exasperata*, *Milicia excelsa*, *Terminalia superba*, *Triprochiton scleroxylon*, and *Ceiba pentandra*.

In Lekié, where the population pressure is high, most of the economically important trees have been removed. Farm activities are very intensive and the dominant vegetation type is of degraded secondary forest or fallow lands with patches of grass fallow increasing from south to the north. Tree species such as *Musanga cecropioides* and *Albizia zygia* dominate the landscape. *Chromoleanae odoratum* and *Panicum maximum* are the common fallow species and are associated with the practice of short fallow cycle.

The dominant soil types in all three divisions are ultisols and oxisols. However, the soils of Lekié are more fertile and moderately acid (pH 1:1 H<sub>2</sub>O = 5 to 6) compared to the very acid (pH 1:1 H<sub>2</sub>O = <5), low cation exchange capacity and high aluminium saturation (>40%) associated with the soils of Mvila and Haut Nyong divisions. This probably explains the relatively high population density in Lekié division compared to east and south Provinces.

The cropping system of all three divisions include the fallow based food crop production system, the semi-permanent cash crop production system and the multistrata home garden system. The food crops include egusi melon (*Cucumeropsis manni*), cassava (*Manihot esculenta*), maize (*Zea mays*), groundnuts (*Arachis hypogaea*) and plantain (*Musa spp.*). The main cash crops are coffee (*Coffea robusta*) and cocoa (*Theobroma cacao*). In home gardens, farmers plant several crops ranging from vegetable crops such as green pepper (*Capsicum annum*) to large fruit trees such as mango (*Mangifera indica*), safou (*D. edulis*) and *Ricinodendron heudelotii*. Cash crop production is lower in the eastern province than in the other two provinces.

#### FIELD SURVEY

A field survey was undertaken to collect data on production, consumption and marketing of

main NTFP so as to determine their economic potential and social value. We also gathered information on the uses, management and farmers' desired improvement objectives for *D. edulis*. A multi-stage procedure was used to choose the villages and farmers from the identified strata. First, on the basis of grids laid over a divisional area map, grid cells of 5 × 5 km were formed. The division was then split into four quadrants each containing an equal number (4–5) of contiguous grids. From each quadrant a grid cell was chosen randomly from which a village was also randomly selected. Thus, in each stratum, three to four villages were selected. The selected villages were Djouyaya, Ntolock, and Bayong I (low accessibility—Haut Nyong division), Mefou, Ebolobola, Mang and Yama (medium accessibility—Mvila division) and Nkolfeb, Eman, Lobo and Tala (high market accessibility—Lekié division). At each selected village, 7–8 farmers were picked randomly from an available list of farmer households in the villages which were available from the extension officer responsible for the village. In all, 80 interviews were held with individuals or groups of individuals. Both male and female members of the household were interviewed. Key informants were also identified from each village and were asked an additional set of questions.

The interview team consisted of an International Centre for Research in Agroforestry (ICRAF) staff and three scientists from the national agricultural research programme of Cameroon—the “Institut de Recherche Agronomique pour 1 Développement” (IRAD). The team was split into 2 groups for conducting the survey.

Economic potential is defined in terms of current household value of production of *D. edulis*. The value of production was estimated as the product of quantity and the price/unit of production. Quantity produced is a sum of quantity sold and quantity consumed plus other uses which includes gifts. Production, sales and consumption data were oral estimates obtained from 26, 16, and 30 growers/collectors in the Lekié, Haut Nyong and Mvila divisions, respectively. Farm-gate prices used for this analysis were obtained by deflating the reported market prices by 20% if the distance to markets where the products were sold was greater than 20 kms. Thus, the potential farm-level economic value of the species for each respondent was estimated by mul-

tipling their production estimate by farm-gate prices. The value reported is the average for each strata.

## RESULTS AND DISCUSSIONS

Table 2 summarizes information on density and mode of propagation including main source of seed when planted and criteria for choice of seed. The percentage of farms with *D. edulis* trees ranges from 94% in Mvila to 80% in Haut Nyong. The average number of trees per grower was variable, with 21, 5 and 12 trees in Lekié, Haut Nyong and Mvila, respectively.

### MODE OF PROPAGATION

Planting of seedlings from pre-germinated seeds is the main mode of propagation in all 3 divisions. In fact, it is the only mode mentioned in Haut Nyong division. Next in importance is retention and protection of plants found in the fields. Transplanting of wildings is carried on, more so in Mvila division than in the Lekié. The three main sources of seeds, when the species is planted, are from selected tree on own farm, market place, and neighbours in Lekié and Mvila divisions; they are the same for Haut Nyong with the exception that their ranking differs. These findings suggest that *D. edulis* has been integrated in the farming system. Criteria for seed selection are similar across the three divisions although the relative importance differ. Large and good tasting fruits are the top two at all sites. Key criteria are large fruit trees, good tasting fruits, good production, yearly production and early maturity. The relative importance of fruit size in the Lekié and Mvila divisions is most likely related to the importance of sales in these divisions and because of the high prices they fetch in Yaoundé (Lekié) and in Gabon (Mvila). These results are in agreement with Leakey and Ladipo (1996) who found a high correlation between fruit size and market price of *D. edulis*. Fruit taste is more important in the eastern province (Haut Nyong) and is probably due to the relatively higher level of consumption of the fruit in the region.

### USES, NICHES, MANAGEMENT AND IMPROVEMENT OBJECTIVES

There is a variety of non-food uses for *D. edulis* (Table 3). Medicinal use of *D. edulis* is more frequent in Lekié (6 of the 26 farmers interviewed) and mostly used for treating yellow fe-

ver, diarrhea and anemia. The bark and leaves are the main parts used. Only two of the 16 farmers in Haut Nyong use *D. edulis* as medicine. No farmer in Mvila division used the species for medicinal purposes. This may be due to the presence still of a rich flora providing the inhabitants of this division with a variety of options for medicinal use.

Other uses identified for *D. edulis* include dead branches for firewood, leaves for fodder, poles, and stakes for yams. These uses are similar in all the divisions with the exception of the use as stakes which is absent in the Haut Nyong division.

In all three divisions, tree crop fields, home gardens, and food crop fields are the leading niches for *D. edulis*. The trees are also found in fallow lands and in virgin forests areas. No farmers collected *D. edulis* from the forest in the Haut Nyong and Mvila divisions. About 8 percent of farmers in the Lekié collected the species from the forest. This may be due to population pressure on the land leading to exploitation of the species in this niche.

Specific management tasks are undertaken on this species including fertilizing and pruning. Few farmers reported using disease and insect control techniques.

*Dacryodes edulis* is harvested primarily by climbing. Eighty-eight per cent of the respondents in Lekié division harvested by climbing compared to 73% in Haut Nyong and 50% in Mvila division. Some farmers also gather what has fallen beneath the trees. Gathering is usually undertaken for bigger trees. No processing of *D. edulis* was reported in Mvila division in contrast to Lekié and Haut Nyong divisions where 15% and 27%, respectively, process the species. Processing of *D. edulis*, mostly undertaken by women, involves removing the seeds, boiling the pulp of the fruit and then drying it. This allows for conservation of the pulp for a long period of time.

An overall analysis of farmers' assessment of the nature of the different management tasks undertaken for *D. edulis* shows contrasting results. Harvesting by climbing was rated as much work by 81% of the farmers responding to this question in Lekié, 69% in Haut Nyong and 47% in Mvila. Pruning, harvesting by gathering, disease and insect control, processing and fertilization were each considered to involve much work by less than 15% of the farmers in all 3 divisions.

TABLE 2. DENSITY AND MODE OF PROPAGATION OF *D. EDULIS* (G. DON) HJ LAM IN THE HUMID LOWLANDS OF CAMEROON.

Variable	Level of market accessibility		
	Low: Haut Nyong (N = 16)	Medium: Mvila (N = 30)	High: Lekié (N = 26)
Local names (ethnic group)	Soh (Mpong Mpong); Cha'a (Maka)	Assah (Bulu)	Assah (Eton)
% Farms with tree (average no. of trees/grower)	80 (5)	94 (12)	93 (21)
Mode of propagation:			
Plant seeds	12 (75%)	22 (73%)	24 (92%)
Retain/Protect	—	8 (27%)	9 (35%)
Transplant wildings	—	8 (27%)	2 (8%)
Main source of seed if planted:			
Own farm, selected tree	4 (25%)	21 (70%)	17 (65%)
Own farm, any tree	1 (6%)	2 (7%)	—
Market place	6 (38%)	13 (43%)	16 (62%)
Neighbors	6 (38%)	10 (33%)	12 (46%)
Tree experts	—	1 (3%)	3 (12%)
Nurseries	1 (6%)	1 (3%)	2 (8%)
Criteria for selection of seed:			
Large fruit	11 (69%)	22 (73%)	22 (85%)
Good tasting fruit	12 (75%)	21 (70%)	21 (81%)
Good production	3 (19%)	10 (33%)	13 (50%)
Yearly production	1 (6%)	9 (30%)	11 (42%)
Early maturity	1 (6%)	5 (17%)	5 (19%)

TABLE 3. FARMERS' USES, NICHES, MANAGEMENT AND IMPROVEMENT OBJECTIVES OF *D. EDULIS* IN THE HUMID LOWLANDS OF CAMEROON.

Parameter	Level of market accessibility		
	Low: Haut Nyong (N <sup>a</sup> = 16)	Medium: Mvila (N <sup>a</sup> = 30)	High: Lekié (N <sup>a</sup> = 26)
Uses <sup>b</sup> (non-food):			
Firewood	10 (63%)	22 (73%)	19 (73%)
Medicinal	2 (13%)	—	6 (23%)
Fodder	4 (25%)	2 (7%)	6 (23%)
Stakes	—	2 (7%)	4 (15%)
Poles	1 (6%)	—	1 (4%)
Niches (average no. of trees):			
Tree crop fields	13 (3)	26 (9)	24 (13)
Home garden	6 (1)	14 (3)	14 (3)
Food crop fields	3 (1)	4 (2)	11 (3)
Virgin forest	2 (1)	—	2 (1)
Fallow land	1 (1)	3 (1)	—
Management tasks undertaken:			
Harvesting (climb)	11 (69%)	15 (50%)	23 (89%)
Harvesting (gather)	1 (6%)	9 (30%)	7 (27%)
Pruning	6 (38%)	7 (23%)	13 (50%)
Disease/Insect control	2 (13%)	4 (13%)	5 (19%)
Processing	4 (25%)	—	4 (15%)
Fertilization	4 (25%)	4 (13%)	3 (12%)
Improvement objective:			
Good tasting fruit	9 (56%)	16 (53%)	20 (77%)
Fruit size	6 (38%)	18 (60%)	17 (65%)
High yield	3 (19%)	5 (17%)	10 (39%)
Storability	4 (25%)	—	6 (23%)
Reduced time to bearing	—	5 (17%)	6 (23%)
Pest/disease resistance	5 (31%)	—	—
Regularity	—	6 (20%)	—

<sup>a</sup> Number of growers/collectors.

<sup>b</sup> All numbers except those in parentheses represent numbers of respondents.

Improvement objectives are similar across the three divisions. Good tasting fruit, increased fruit size, high yield, improving storability, regularity, reducing time to maturity and pest and disease resistance are the key improvement objectives in the study area. In the Lekié and Mvila divisions where there are big markets—Yaoundé for Lekié and Gabon for Mvila division—for *D. edulis* fruits, we note the emphasis of farmers on good tasting fruit, fruit size and higher yield. This is prompted by the potential economic value of the fruits in these markets. As a whole, these improvement objectives match very well with criteria farmers use for selection of seeds when they plant the species. However, although respondents identified harvesting by climbing as a difficult task, reduced tree height is not among the top five improvement objectives.

#### EFFECT ON TREE AND FOOD CROPS

Farmers' perceptions of the effect of *D. edulis* trees on both tree crops (such as cocoa and coffee) and food crops are mixed (Table 4). The positive effect (increase in yield) on tree crops attributed to *D. edulis* trees is probably the result of the shade it provides. In Haut Nyong division, a larger proportion of respondents believe that the species has a negative effect (reduced yield) on tree crops. As for the effect on food crops, most farmers had no opinion. Where an opinion was given, in all divisions respondents consistently associate *D. edulis* with a negative effect on food crops. On one hand, farmers have a high number of trees on their land and, on the other hand, they associate a negative effect with the tree. These results highlight the importance of the species to land users. Another implication of

TABLE 4. EFFECT OF *D. EDULIS* TREE ON THE PRODUCTION OF DIFFERENT TREE AND FOOD CROPS IN THE HUMID LOWLANDS OF CAMEROON (% OF RESPONDENTS).

Effect	Nature	Level of market accessibility		
		Low: Haut Nyong (N = 16)	Medium: Mvila (N = 30)	High: Lekié (N = 26)
		% of farmers		
Effect on tree crop	Increase (positive)	13	17	27
	Reduce (negative)	40	13	23
	Mixed (no effect)	13	13	23
	Don't know	34	57	27
Effect on food crop	Increase (positive)	0	0	0
	Reduce (negative)	33	10	27
	Mixed (no effect)	0	7	4
	Don't know	67	83	69

this finding is that proper management techniques are essential in order to ensure optimal interaction between *D. edulis* and the associated crops.

#### ECONOMIC VALUE AND POTENTIAL

Table 5 shows mean production estimates and a seasonal break-down of the average value of production of *D. edulis* in the three divisions. Prices were found to vary greatly by season and

by fruit size as found in previous studies (Leakey and Ladipo 1996). Early in the season prices are usually high. The lowest prices are observed at the middle of the season. Because of the seasonal variation in price, a breakdown of the value of production is presented by season. The production season for the species runs from March to November in the Lekié division, June through October in Haut Nyong and March through September in Mvila. Peak production is

TABLE 5. MEAN ANNUAL PRODUCTION ESTIMATES (KG/GROWER) AND YEARLY VALUE OF PRODUCTION (FCFA<sup>a</sup>/GROWER) OF *D. EDULIS* FRUITS IN THE HUMID LOWLANDS OF CAMEROON.

Variables	Level of market accessibility		
	Low: Haut Nyong	Medium: Mvila	High: Lekié
Production (total)	72	288	619
Sales <sup>b</sup>	29	87	251
	(40%)	(30%)	(41%)
Consumption <sup>b</sup>	42	180	367
	(60%)	(63%)	(59%)
Other <sup>b</sup> (e.g., gifts)	0	21	0
	(0%)	(7%)	(0%)
Value of production <sup>c,d</sup>			
Using beginning of season prices	9000	63 360	80 470
	(3010)	(14 440)	(49 900)
Using middle of season prices	4320	31 680	40 235
	(1440)	(7180)	(24 900)
Using end of season prices	9000	37 440	77 375
	(3010)	(8485)	(48 040)

<sup>a</sup> \$USA = 500FCFA (1996).

<sup>b</sup> Figures in parentheses are percentages of total production.

<sup>c</sup> Numbers in parentheses are standard errors. All figures are rounded to nearest 5FCFA and value of production is found by multiplying deflated farm-gate prices by production.

<sup>d</sup> Deflated farm-gate prices used are as follows: low market accessibility area (Haut Nyong), 125FCFA/kg, 60FCFA/kg and 125FCFA/kg for beginning, middle and end of season, respectively; 220FCFA/kg, 110FCFA/kg and 130FCFA/kg for beginning, middle and end of season, respectively, at the medium market accessibility area (Mvila); and 130FCFA/kg, 65FCFA/kg and 125FCFA/kg for beginning, middle and end of season, respectively, at the high market accessibility area (Lekié).



during the period June–August in all three divisions.

The highest level of production is in the Lekié division with average annual production of 619 kg/grower. About 41% of the production is sold while the remainder is consumed by the grower. The total value of production per year based on beginning of the season prices is about 80 470 FCFA/grower, approximately \$US161.00. If the lowest prices observed are used, this corresponds to 40 235 FCFA/grower (about \$US80.00).

The production of *D. edulis* is the lowest in the Haut Nyong division where only about 72 kg were estimated to be produced each year. Forty-four per cent of the production is sold and the rest is consumed. The annual value of production ranges from 4,430 FCFA/grower—about \$US9.00—(middle of the season prices) to 9000 FCFA/grower (end of season prices)—an equivalent of \$US18.00.

In Mvila division, 288 kg of *D. edulis* is produced on the average. Thirty per cent (lowest of the three divisions) of this production is sold and the remainder is for household consumption. Based on prevailing prices in the division, the species can contribute from 31 680 FCFA (\$US63.00) to 63 360 FCFA (\$US127.00) to household income each year.

A division-wide comparison of household consumption of the species shows that consumption is highest in Mvila division. On average, about 60% of the total quantity of *D. edulis* produced is consumed. The proportion of the species sold is highest in the Lekié division followed by the Haut Nyong division and lastly by Mvila division. The Lekié and Mvila divisions benefit from the Yaoundé area and Gabon markets, respectively.

### SUMMARY AND FURTHER RESEARCH NEEDS

*Dacryodes edulis* is a highly valuable species in the humid lowlands of Cameroon. On the basis of peak season prices, the estimated annual value of production ranges from 4430 FCFA/grower (approximately \$US9.00) in Haut Nyong to about 40 235 FCFA/grower (\$US80.00) in Lekié. *D. edulis* fruits are worth 31 680 FCFA (\$US63.00) in Mvila. The fruits are more valuable in the densely populated region of Lekié than in the remote areas of Haut Nyong division as they fetch higher prices in the urban areas of Yaoundé. In comparison with other important in-

digenous tree species in the area such as *Irvingia gabonensis*, *Garcinia kola* and *Ricinodendron heudelotii*, *D. edulis* is among the top two species in value in the region (Ayuk et al. 1999; Ayuk et al. nd). Approximately 60% of the production is consumed and hence, the species plays an important role for food security. On the basis of a larger sample size and more rigorous sampling method, the results of this study confirm earlier results (Mollet et al. 1995) showing the relative importance of *D. edulis* in the humid lowlands of Cameroon.

Farmers have a strong interest in growing *D. edulis*. Most farmers plant seedlings and most have opinions as to how the species could be improved. Based on its high current value, improving the species in ways suggested by farmers could reap substantial benefits.

Future research should seek to determine market opportunities for *D. edulis* and the marketing constraints faced by farmers and traders. Studies on the marketing channels of *D. edulis* fruits, market margins and quantifying the value of products such as medicine, firewood, fodder, stakes and poles need to be undertaken.

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