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FUELWOOD: A REGIONAL APPRAISAL OF WEST AFRICAN NEEDS IN ENERGY, ECOLOGY AND FOREST COVER

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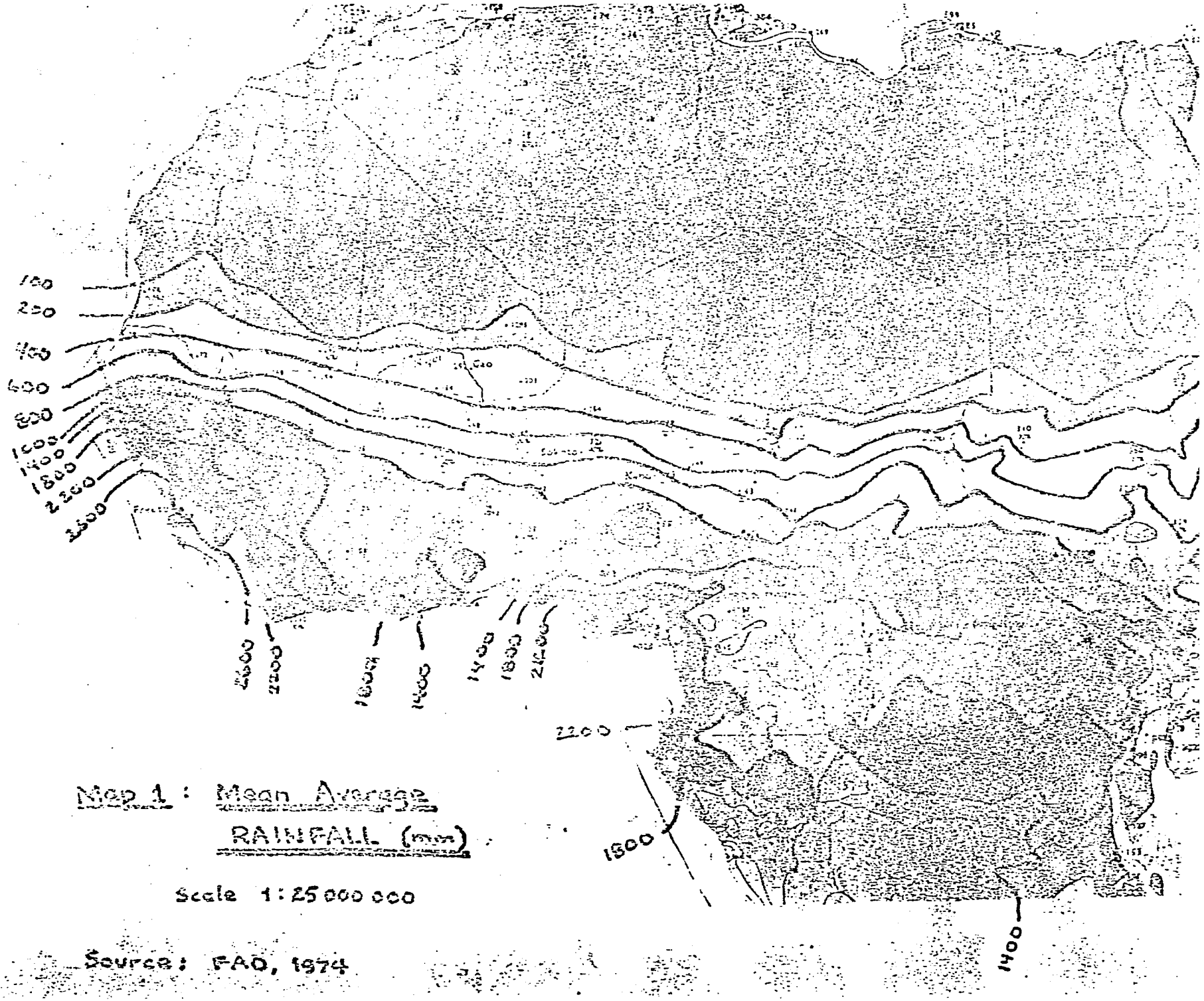
PREFACE

The intent of this overview is to provide the interested reader with a regional perspective to fuelwood development in West Africa. The linkages between fuelwood, and such items as environment, forest cover, agriculture, population growth and non-fuelwood energy are intimate and this report will attempt to address each in the context of fuelwood production and use. The geographical scope of the paper has deliberately been restricted to the Western portion of the REDSO/WA sub-region, delimited by the Sahara to the North, the Atlantic Ocean to the South and West, and the countries of Chad and Cameroon to the East.[1]

This paper has been developed as a direct result of REDSO/WA field experience and observations in the forestry and energy sectors in its' sub-region. This assessment is intended to stimulate greater multi-disciplinary thought and discussion on what could easily become, if it is not already, one of the most pressing development problems in our area. It should be emphasized at the outset that the observations and inclusions contained herein are based on highly empirical data and will certainly be modified as new study, project work and data collection evolves quantitatively and qualitatively in West Africa. Much of this work is currently under way, but results incomplete.

The opinions expressed herein, and the accuracy of the data which support them, are the sole responsibility of the author, J. A. Hradsky, development economist, currently stationed in USAID/Bangkok, Thailand. Although this paper was written prior to Mr. Hradsky's departure from REDSO/WA in 1981, it should in no way be construed to reflect official USAID policy or opinion.

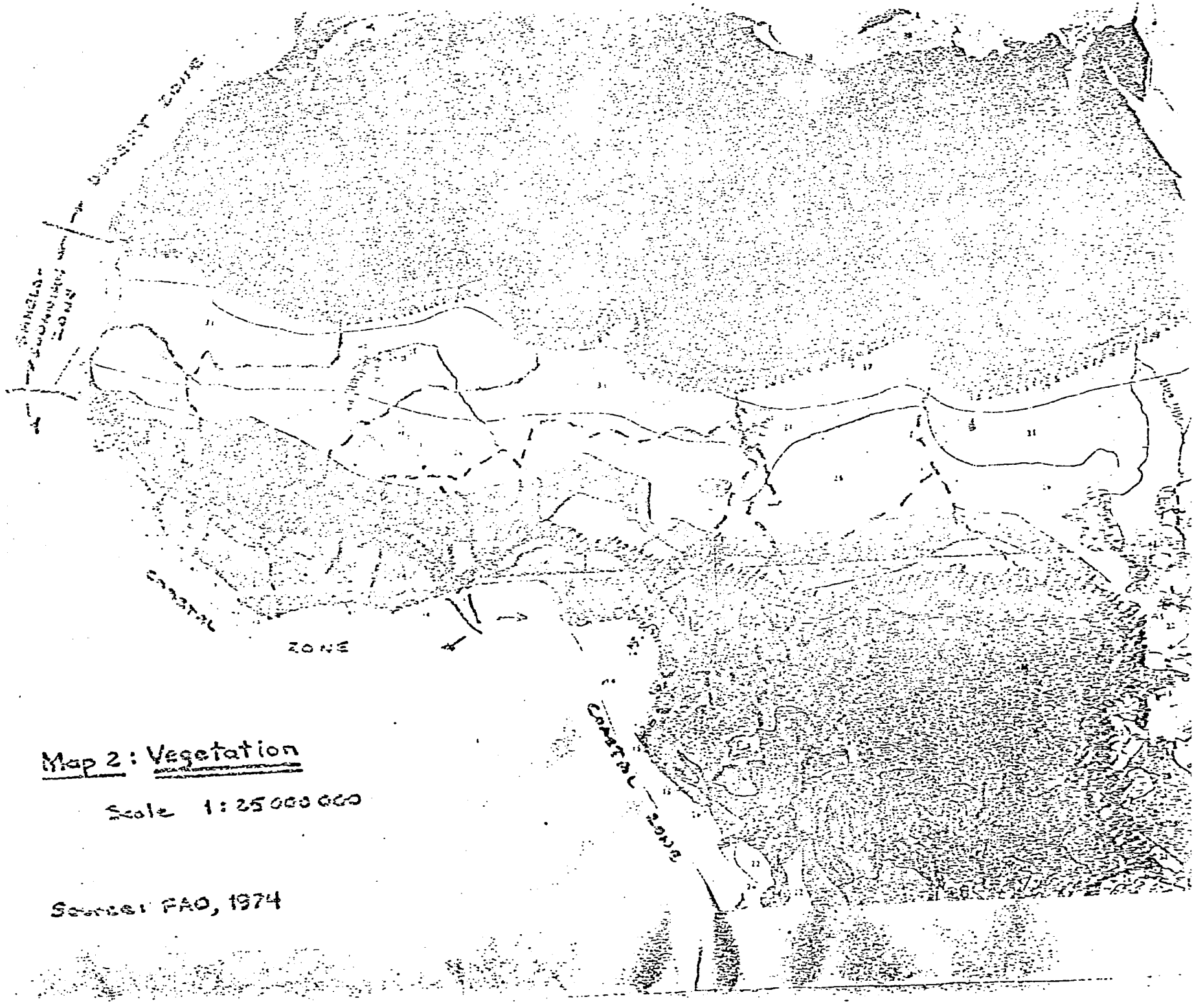
1. This area corresponds exactly with that containing the member states of the Economic Community of West Africa States (ECOWAS)).



Map 1: Mean Average RAINFALL (mm)

Scale 1:25 000 000

Source: FAO, 1974



Map 2: Vegetation

Scale 1:25 000 000

Source: FAO, 1974

I. INTRODUCTION TO THE FUELWOOD SECTOR IN WEST AFRICA

Fuelwood (firewood and charcoal) availability and quality is directly dependent upon the size and character of local forest cover. It would seem most appropriate, therefore, to first briefly describe the nature of forest cover in West Africa.

A. Forest Cover

Because of the fairly homogeneous nature of West African topography and soil types, rainfall is a key determining factor for forest cover growth in that region. Rainfall patterns are represented by isohyetal lines running roughly in an East-West direction, which increase in intensity as one moves from North to South (see Map 1). Forest vegetation follows these patterns fairly closely (see Map 2), demonstrating their homogeneity spatially in East-West orientations and becoming increasingly dense as one moves from North to South.

For the sake of simplicity, this paper will deal with three broad classifications of forest zone, which we will categorize as "Coastal", "Sahelo-Sudanian" and "Desert". It should be made clear that this generalization is only intended to be illustrative and presents a partial picture of the complexity of West African forest resources.

1) Coastal Zone: Basically the zone of dense moist tropical forest, the Coastal Zone is characterized on Map 1 by annual rainfall levels of 1500-3000 mm (and occasionally higher). It includes significant portions of the coastal states of Sierra Leone, Guinea, Ivory Coast, Ghana and Nigeria and virtually all of Liberia. Most export production of West African tropical woods and its derivatives come from this zone, as well as that of all major tree crops (cccoa, coffee, rubber, palm oil, bananas, coconuts).

2) Sahelo-Sudanian Zone: This classification is basically within the 100-1500 mm. rainfall belt. It encompasses a wide variety of vegetative covers, ranging from the thinly wooded and scrub grasslands of the Sahelian North (100-500 mm), to the tropical woodland of the South (1000-1500 mm). This area also roughly represents the zone of human habitation most severely affected by the recent drought.

3) Desert Zone: Under 100 mm. of rainfall and little or no vegetative cover. This zone covers a considerable percentage of the northernmost West African states (Mauritania, Mali, Niger). As a zone of extremely limited potential for forestry and human development, the desert category is included here only for the sake of comprehensiveness.

The exact area covered by West Africa's forest cover is difficult to estimate with precision, lacking comprehensive forest inventories, precise definitions and given the rapid evolution it now appears to be undergoing. Table 1 illustrates the approximate distribution of forest area worldwide, according to the President"s Global 2000 Report. Surprisingly enough, with only 6% of its land mass occupied by closed forests, Africa is the world's least forested continent.

Table 1: World Forest Area (1973)

(000 000 ha)

	Forest Land	Closed[1] Forest	Open Wood-land	Total[2] Land Area	Closed Forest as Percent of Land Area (%)
Africa	800	190	570	2,970	6
Pacific Area	190	80	105	842	10
Asia	530	400	60	2,700	15
Central America	65	60	2	272	22
North America	630	470	176	1,841	25
South America	730	530	150	1,760	30
Europe	170	140	29	474	30
U.S.S.R.	915	785	115	2,144	30
World	4,030	2,655	1,200	13,003	20 (Avg.)

Source: The Global 2000 Report, 1980

1. "Closed Forest" is defined by FAO as an area where tree foilage and branches cover 20% or more of the ground in question. "Open Woodlands" are the wooded savannah areas containing less than 20% forest cover.

2. N.B. - "Forest Land" is not always the sum of closed forest plus open woodland. Other categories included under this title are scrub and bushland areas where forest regeneration is not taking place.

Of Africa's total 190 million hectares of closed forest area, almost 85% or 160 million hectares (Economic Commission for Africa: 1972) is in the Coastal Zone (see Map 1) running from Guinea through Zaire. Only 23 million hectares of this closed forest belt are located in West Africa, however. Perhaps as much as 40% of the total West African closed forest is located in Liberia and Ivory Coast.

B. Fuelwood in the Context of Total Forest Utilization

The role played by the forest in servicing the total development needs of the vast majority of West Africans is vital. Although fuelwood forms the focus of this paper, it is imperative to examine the total forest utilization system to understand the overall requirements which are, and will be, placed upon its limited resources over time. In undertaking such a review of forest utilization, we have regrouped forest utility functions into three broad categories: household consumption, industrial consumption and environmental. The description of "utility functions" is useful in understanding human-forest relationship viewed in the context of need. Above and beyond these functions, and by no means negligable in terms of the total question of

deforestation, is, as will be illustrated later, the destruction or waste of the forest by man as a result of his subsistence agricultural, pastoral or other traditional practices. This second category of deforestation will be presented subsequently.

1. Household Consumption Uses

(a) Cooking: The major human use of the forest in West Africa is to supply household energy (fuelwood). By far the largest use of fuelwood is in cooking, although small amounts may be utilized for such other household tasks as heating and ironing.

The basic tendency is to utilize fuelwood in the form of firewood in rural areas, and charcoal and firewood in urban areas, although the urban charcoal/firewood mix may vary significantly. A recent study in Senegal[1] estimates the ratio of charcoal to firewood utilization at 90:10 in Dakar, 80:20 in St. Louis and 40:60 in most other cities. In the Ivory Coast[2] these same ratios are cited as 60:40 for Abidjan, 40:60 in Bouake and 20:80 for most other urban centers. In the Sahelian states most major cities are still heavily oriented to firewood use, but are increasingly turning to charcoal over time. The high correlation between charcoal preference and urbanization can probably be linked to the easier storage and transport of charcoal in congested urban areas, the higher incomes of urban dwellers and the relatively smokeless cooking which can be obtained from charcoal. The tendency would appear to be particularly reinforced by the local availability of forest cover and by the cost of transport.[3] Dakar, for example, is heavily oriented to charcoal, is the largest Sahelian city (800,000 in 1976), and has no locally utilizable forest cover for fuelwood production. Abidjan, however, is located in the densely forested coastal zone and still consumes a large part (40%) of its total fuelwood needs in firewood. As the area in closest proximity to Abidjan is deforested, however, an accelerating preference for charcoal is clearly being noted.

It is interesting to note that improved income levels do not seem to strongly affect the level of utilization of fuelwood versus other domestic energies (gas, electricity, kerosene). In a 1975 study[4] a sample of 2294 families in Dakar indicated globally that 89.6% utilized charcoal, 7.1% utilized bottled gas and 2.4% used firewood as their primary energy source for cooking. Variance above or below these levels was generally less than 5%

1. USAID/Senegal, 1979
2. S.I.G.E.S., 1975
3. Urban firewood use, on the other hand, is occasionally reinforced by local cooking methods.
4. University of Dakar, 1975

for all socio-economic sub-groups. In Abidjan, the same stability in utilization of fuelwood versus other energies has been noted[1], however, revenue does appear in that city as a factor in the shift from firewood to charcoal. That survey indicated that households with a monthly income greater than 75,000 CFA ($268 at 280CFA = $1) invariably had already abandoned firewood in favor of charcoal.

Cooking Efficiency: The efficiency of current fuelwood utilization techniques appears open to considerable question. Firewood is almost universally used for cooking in conjunction with the three stone system upon which the pot is posed. Charcoal, when used for cooking, is generally consumed in a small metal apparatus called locally a fourneau malgache (malagasy cooker).[2] Many informed observers claim enormous energy losses through these cooking devices, although local evidence does not appear clear at this time. More will be said on this topic in Section III of this report.

Charcoal Conversion Efficiency: For the moment, virtually all conversion of wood to charcoal is done through extremely rudimentary artisanal techniques which produce generally low quality charcoal and entail considerable waste. Based on REDSO/WA observation, the most primitive conversion systems would appear to be located in the less populated areas of the Coastal forest zone, where wood remains abundant and charcoal conversion is not a widely used process. The simplest method used in those areas is simply to dig a shallow hole or trench, fill it with cut wood, cover it with dirt, light it and let it smolder several weeks until carbonization is satisfactorily complete. Yields under this method are very low, perhaps 10% or less of the dry weight of the wood and carbonization is often incomplete.

The most sophisticated local process in West Africa is probably the so-called "Guinean method", originating in the Fouta Djalon area of Guinea and utilized probably most extensively in Senegal, where the demand for charcoal is high. The method requires the careful stacking of appropriately cut and sized firewood in a circular fashion around a vertical centerpost so as to form a mound several feet (sometimes yards) high, which is then covered with a layer of straw and a layer of dirt. The centerpost is withdrawn so as to serve as a chimney, into which air is drawn through the exposed straw at the lower extremities of the mound. Proper carbonization may require 1-2 months, but yields are good by area standards - perhaps as much as 20% of the dry weight of the wood.

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1. S.O.E.I., 1978
2. A sheet metal brazier with a grate to contain charcoal under a pot placed upon it and with small holes for admission of air at the bottom. Also known as a "feu malgache". See Gern, Jacobs and Evans: 1980, for details.

Worthy of particular note, in our opinion, is an improvement on the Guinean method recently developed in Ziguinchor, Senegal, by an American FAO technician, Ed Karch. His modifications focus on improved overall ventilation of the mound during the carbonization process through the introduction of a simple metal chimney and improved aeration under the stacked wood. In repeated tests, his method, known locally as the fourneau casamancais yielded 50% more charcoal (or approximately 30% of dry weight) than the traditional method, and twice as fast. Prior to his departure from Ziguinchor in 1980, Mr. Karch had considerable success in interesting local charcoal makers in his method.

Fuelwood Marketing: The marketing of fuelwood is highly informal. In rural areas firewood gathering is an everyday task of women and children. Finding enough fuelwood for day-to-day cooking needs is clearly an extremely important responsibility for every West African household. In a more sophisticated marketplace (larger villages, towns) one generally finds "professional" woodcutters and charcoal makers, who, once they have bundled or sacked their produce, work through, or sell to, transporters who shuttle the produce to the marketplace, where it is either sold wholesale or broken down into smaller units for sale by street merchants. In urban areas it is not unusual to find charcoal sold by the bucket or kilo. Current (1981) retail prices registered by REDSO for small quantities of charcoal in West African urban areas vary highly by city (6¢/kg. in Conakry, 25¢/kg. in Abidjan, 40¢/kg. in Ouaga) and may fluctuate as much as 50% seasonally.

In rural areas women often spend 2-3 hours per day in gathering their fuelwood supply. In urban areas, expenditures for family fuelwood supplies can commonly cost as much as 30% of a total family budget. On the average it is estimated that consumption of fuelwood in West Africa is on the order of .5-1.0 m^3/person/year.[1]

(b) Non-fuelwood household uses: Forests fulfill a number of non-fuelwood roles in servicing basic human needs for West African populations, including construction (especially poles for roofing), artisanal furniture production, artistic expression, fruit (both food and cash crop production), medicinal goods, transport (dugouts and rudimentary rafts), animal fodder, etc. As an order of magnitude, it is often estimated that 10% of total household consumption of forest cover is represented by non-fuelwood consumption. The fact that non-fuelwood needs consume a smaller part of forest reserves than those of fuelwood does not necessarily make them less important from the point of view of the consumer, however. Especially in rural areas, the non-fuelwood roles (e.g., poles, medicinal products, supplementary nutrition, etc.)

1. These consumption rates, as is true throughout the paper, are in solid wood equivalent.

can be construed as extremely important to one's everyday existence. This fact should not be neglected (although it generally has been) when selecting species for reforestation projects, especially where production is destined for a highly localized area, as is the case with most community forestry programs.

2. Industrial Consumption Function (The Timber Industry)

The industrial role played by West African forests is fairly small in proportion to that of household consumption and is highly localized to the coastal forest zone. Industrial production of wood includes essentially logs and processed woods (furniture, construction, lumber, plywood). The total export volume of logs and sawn wood has probably already peaked in all West African states except Liberia and, potentially, Guinea Conakry and Sierra Leone. Nevertheless, forest industries, particularly log export activities, represent an important percentage of foreign exchange earnings for a limited number of coastal states, as is noted in Table 2, attached. Considerable attention is increasingly being focused on reforestation activities by affected states so as to preserve the long-term industrial potential of their forests. Most forest-poor Sahelian states import a large proportion of their construction wood requirements from the coastal states.

3. Environmental Function

The environmental role played by the forest has long been recognized, although quantitative assessments of its impact are difficult to make. Experience in both Sahelo-Sudanian and Coastal Zones (particularly Coastal rainforest) has shown more than once the dramatic effect that man can have on the fragile and complex local ecosystems through his deforestation activities.

A generalized model of environmental impacts associated with deforestation is noted in Figure 1. As a general statement, deforestation can be expected to lead to increases in soil erosion, decreases in soil moisture, deregulation of stream flows and water availability, irreversible loss of flora and fauna and, potentially, major shifts in climate or rainfall.

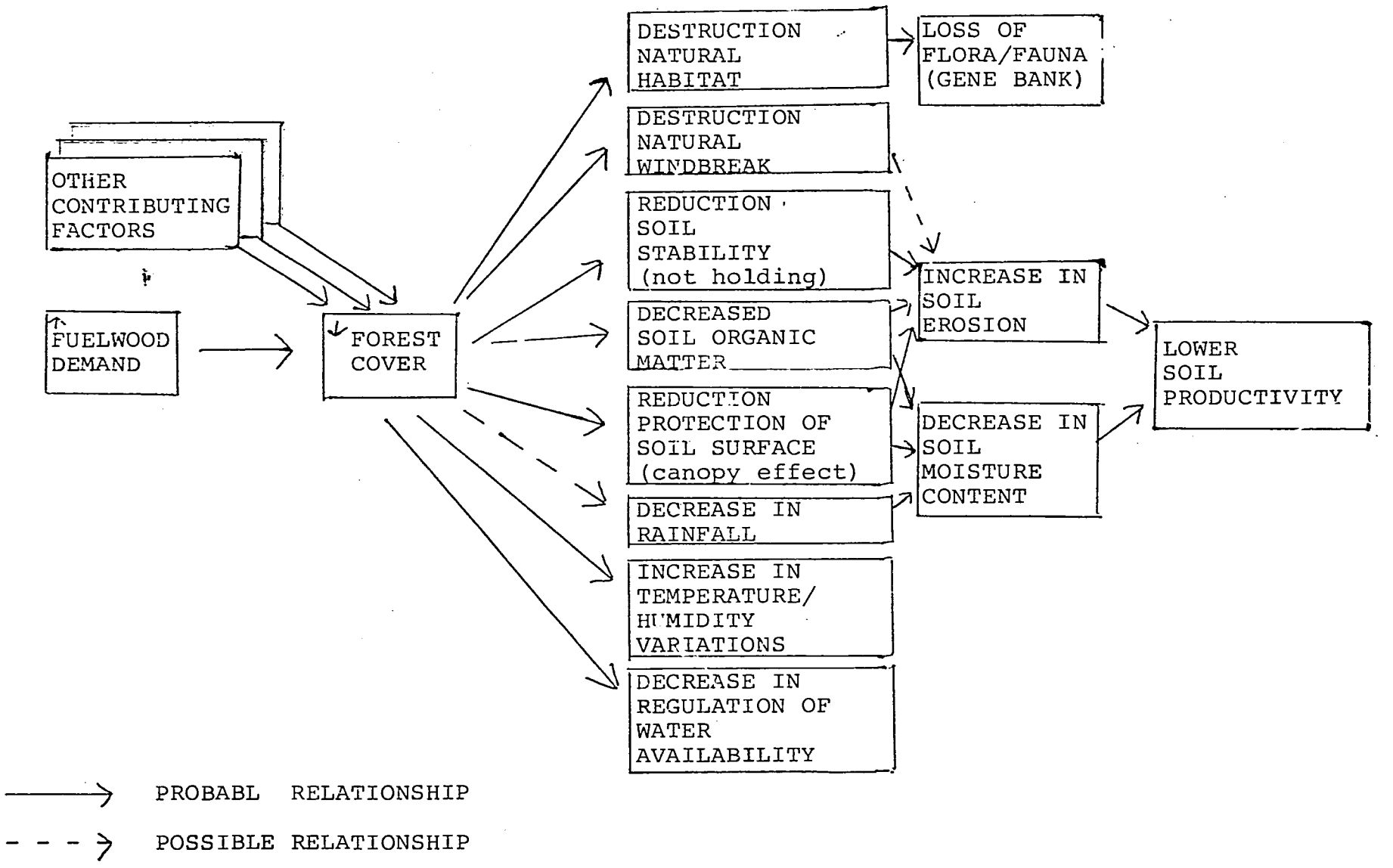
Most environmentalists feel that reforestation is one of the front line forces in current attempts to stop/reverse the process of desertification in the Sahelian states.

Table 2: TIMBER PRODUCTION IN WEST AFRICA

COUNTRY	TIMBER PRODUCTION	TIMBER EXPORTS	TIMBER EARNINGS	TIMBER AS % OF TOTAL EXPORT EARNINGS	OBSERVATIONS
Ivory Coast	4,800,000 M^3	2,846,000m^3	$317,000,000 (71.3 B CFA)	13%	Principally logs for export. Was 3rd largest earner in 1978 after coffee and cocoa.
Liberia	N/A	Approx. 1,000,000 m^3 (1979)	$ 58,500,000	11%	Third largest export earner after iron and rubber. Considerable untapped potential.
Ghana	Approx. 600,000 tons (1976)	512,000 tons (1976)	$ 38,600,000 (105 M Cedi)	11%	Second export earner after cocoa. Some 25% of total export value in form of processed wood.
Nigeria	N/A	170,000 M^3 (1977)	$ 9 Million (Est. 6 M)	0.1%	Sixth export earner far behind petroleum and others. Declining forests and large internal market have reduced exports.
Guinea Bissau	17,000 tons (1979)	12,000 m^3	$500,000 (16.4 M pesos)	3%	Exports mainly in sawn wood and parquets. Potential for expansion in south of country.

Source: The Economist, 1980 Annual Supplement

FIGURE 1: ENVIRONMENTAL IMPACTS ASSOCIATED WITH DEFORESTATION



C. Deforestation

1. Causes of Deforestation in Perspective: In summary, it is readily apparent that the primary consumption function serviced by West Africa's forest is that of furnishing energy, especially in the form of cooking fuel to the vast majority of the area's rural and urban populations. A very rough, order-of-magnitude recapitulation of estimated current consumption patterns for the West African sub-region is noted below for emphasis.

Table 3: Annual Theoretical Forest Consumption in West Africa

Category	000 000 m^3	% of Total
A. Fuelwood[1]	68.9	75
B. Non-fuelwood[2] (household consumption, poles, tools, etc.)	7.7	8
C. Industrial[3]	15.0	16
Total	91.6	99 (rounding error)

1. Assumes .5m^3/p/yr. consumption over all of West Africa (1977 census figures)
2. Assumes non-fuelwood needs equal 10% of total household needs
3. Combines estimates of domestic utilization and export production.

However, the consumption functions served by West Africa's forest (household, industrial) are not the only major causes of depletion of forest cover.[1] While the forest is clearly a useful (perhaps indispensable) ally to the vast majority of West Africans in meeting their basic consumption and foreign exchange requirements, it is also capable of being perceived as an obstacle to the effective functioning of certain development activities. For the rural poor this generally means a deliberate (because essential) and wasteful destruction of the forest to make way for food or cash crop agriculture[2] (slash-and-burn techniques), improved grazing for animals (fire for pasture regrowth) and hunting practices. In addition, numerous (generally uncontrolled) fires are also set inadvertently through carelessness and such artisanal activities as charcoal production and honey gathering. What

1. It should be noted that Coastal zone logging operations do not, in and of themselves, cause serious damage to the existing forest cover. Forestry operations are generally limited to the cutting of one or two commercially utilizable trees per hectare. Ecological destruction only takes place to the extent that local populations utilize the forestry tracks to penetrate into the forest and create new agricultural lands.
2. In the Ivory Coast, admittedly probably the "extreme" case for West Africa, local specialists currently estimate annual destruction of forest cover for small farm agricultural purposes at 300,000 hectares per year. Some is converted to fuelwood but most is simply destroyed. This volume of wood is probably equal to the fuelwood needs of the entire Sahel for at least two years.

provides the individual with a short-term gain in this case, however, is rapidly proving to be to the long-term detriment of the collectivity.

Individual farmers and pastoralists are not the only actors responsible for destruction of West Africa's natural forest resources. Local governments often ignore the forestry sector in the context of their varied development activities. Large scale agriculture and livestock projects frequently neglect the tree as an integral aspect of the overall development package and, in some cases, actually promote wasteful destruction of the existing forest landscape without due reflection on its immediate human or long-term ecological utility.

Taken into perspective, all of the above can be considered causes for current deforestation trends in West Africa, but individually will vary in importance depending on the local context. As a generalization, deforestation can probably be seen as most vitally linked to fuelwood collection in the Sahelo-Sudanian Zone and to slash-and-burn agricultural techniques in the Coastal Zone. It is important to note that, no matter which zone, the causality behind deforestation patterns is clearly based on basic human subsistence (agriculture, cooking, herding or other basic human needs).[1]

2. Fuelwood and Population Growth: Ultimately, the major determinant of the rate of deforestation and fuelwood availability is probably population growth. Demographic growth in the West Africa states is among the highest in the world, ranging from 2.0 - 4.0%/year, compounded. Urban population growth trends (2-10%/yr.) are generally greater than those in rural areas (0-2%/yr.) due primarily to rural-to-urban migration.

As a generalization, and in light of the previous commentary, this would appear to mean that

a) fuelwood energy demand will continue to grow at rates similar to those of population,

b) deforestation (supply) will continue at roughly similar rates, and,

c) fuelwood users will increasingly shift from firewood to charcoal as urban dwellers command an ever increasing share of the total fuelwood market.

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1. It is precisely for this reason that the common West African government tendency to deal with the deforestation problem through legislation forbidding fires or cutting of wood will probably never fully confront the real issues at hand. At best, this gesture is only symbolic.

The current (1977) estimated distribution of population in our area is noted below:

Sahel states[1]	24.8 million
Coastal states[2]	34.0 million
Nigeria	79.0 million
Total	137.8 million

1. Cape Verde to Niger
2. Guinea Bissau to Benin

For illustrative purposes only, if we assume that both urban and rural population growth will continue at 2.5%/yr. and, furthermore, assume that average fuelwood consumption is .5m^3/person/yr., estimated annual consumption in 1997, for fuelwood alone, will exceed 110 million m^3 of wood, or a natural forest equivalent of over 2 million hectares.

Table 4: Theoretical Evolution of Annual Fuelwood Consumption

	1977		1997	
Area	'000 000 m^3	ha. natural forest[1] equivalent	'000 000 m^3	ha. natural forest equivalent
Sahel	12.4	620,000	20.3	1,016,000
Coastal	17.0	212,500	27.9	348,000
Nigeria	39.5	493,750	64.7	809,000
Total	68.9	1,326,250	112.9	2,173,000

1. Assumes one hectare of mature natural forest yields 20m^3 in the Sahel and 80m^3 in Coastal Zone, including Nigeria.

Remembering that we initially evaluated total closed forest reserves in West Africa at 23,000,000 ha., adding to this perhaps an additional 100,000,000 ha. of wooded savannah, and knowing that fuelwood demand is not the only cause of deforestation, it becomes rapidly apparent that the ecological and energy consequences of such an evolution are bound to be profound in the not-too-distant future.

D. Evolution of Forest Cover Over Time:

Deforestation in West Africa, therefore, begins essentially with population pressure, leading to demands on the natural resource base for greater agriculture and livestock production as well as proportional increases in human consumption (especially fuelwood) and increased frequency of fire. Finally, the scare and irregular rainfall of recent years has seriously inhibited natural regeneration (particularly in the Sahelo-Sudanian Zone) of a number of the less resistant local species. Figure 2 attempts to outline schematically global deforestation relationships from the perspective of the fuelwood system.

Forest cover in West Africa is rapidly disappearing. Slowly the coastal forest cover is turning into Sahelo-Sudanian-type forested savannah, and the Sahelo-Sudanian savannah into desert. The exact magnitude of this phenomenon is difficult to calculate, although several estimates have been advanced in recent years. The World Bank notes in its 1978 policy paper for the forestry sector that [1] "In sub-Saharan Africa the area of closed tropical forest has been reduced by at least 100 million hectares in this century.." More globally, the FAO estimates that "..some two million hectares are lost each year in Africa".

Probably one of the more revealing specific statements on deforestation in the West African region comes from a survey of land and vegetation degradation undertaken in 1975 by the Gambian Department of Agriculture. In that survey, aerial photographs taken in 1948 and 1968 (twenty 10-square mile sample areas of the country) were compared to evaluate shifts in land use patterns over that twenty-year period. The results of the study are noted below:

Vegetation and Land-Use Designation	1948	1968
1. FOREST (complete ground cover by trees, as viewed from above)	28.9%	3.4%
2. WOODLAND SAVANNAH (Tree canopy over 50-50% of ground)	31.3%	4.6%
3. SAVANNAH (25% tree canopy)	14.0%	17.6%
4. THORN AND SMALL TREE (marginal areas, usually not suitable for annual cropping)	7.8%	31.7%

1. IBRD, "Forestry Sector Policy Paper", February 1978

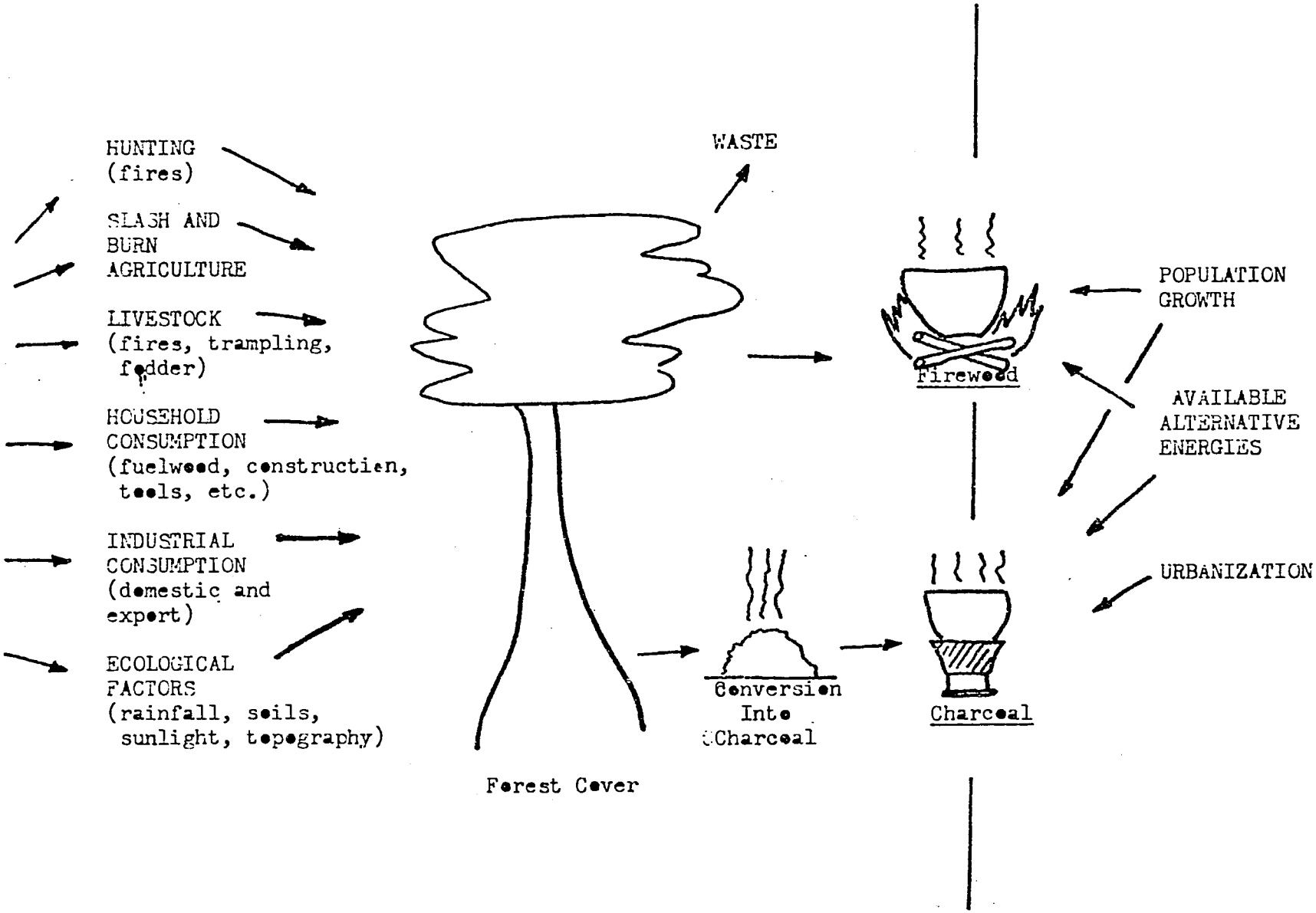

Figure 2: CONTRIBUTING FACTORS TO FUELWOOD SUPPLY AND DEMAND

5.	LOW BUSH SHRUB (some low bush and shrubs, visible bare soil/erosion)	0.4%	19.9%
6.	CROPPING W/FALLOW	17.6%	5.5%
7.	CONTINUOUS CROPPING	0.0%	17.3%
		100.0%	100.0%

The trends registered over time by the study are alarming and include, most notably:

-- rapid depletion of the national forest area (60.2% - 8.0%), represented by number 1 and 2;

-- rapid expansion of marginally useful agricultural areas, including some erosion (8.2% - 51.6%), represented by numbers 4 and 5; and

-- reduction of cropping with evident fallow (17.6% - 5.5%) and a rapid increase in continuous cropping (0.0% - 17.3%).

It can probably be safely assumed that these land use trends are roughly reflective of the situation of much of the Sahelo-Sudanian Zone.

E. Alternatives:

In light of the trends noted above, it is not unreasonable to scrutinize the landscape for current or future alternatives which could mitigate its consequences or slow the trends. This paper has examined the question below from two perspectives which are central to this report and closely related to each other: energy and forest cover.

1. Energy: Alternatives to utilization of fuelwood as a source of energy (especially cooking) for the majority of West Africans are limited, at least in the short and medium-term. The only currently feasible alternatives are probably fossil fuels (especially bottled gas and kerosene) and potentially, enlargement of the electrical grid[1], although, as a general rule, these are theoretically most plausible for urban areas only. A longer timeframe (10-20 years) should hopefully widen the range of options, however, including such possible candidates as solar power (thermal or photo-voltaic), mini-hydro, biogas, pelletization of organic wastes, and wind power. Detailed assessments of all of the most promising alternative technologies are currently being developed by the REDSO/WA Energy Task Force. It would seem apparent, at our current level of knowledge, however, that technical, economic or cultural factors preclude utilization

1. Electricity is itself, of course, generally dependent on fossil fuels for its production.

of any of these alternatives as a viable replacement to fuelwood for the vast majority of West Africans and for probably at least the next decade or two. On the energy side, it would appear that West African nations will need to act quickly to either (a) reduce fuelwood demand through improved utilization methods (improved charcoal conversion, improved wood and charcoal stoves), or (b) increase supply through improved production and forest protection (reforestation, fire prevention, etc.), or both. Table 5 gives some feel for the importance of fuelwood in the context of global energy needs in all West African states today, although the information contained therein would clearly appear to be dated and occasionally inaccurate. It is important to note the apparent general correlation between poverty (in GNP/capita) and fuelwood dependency. That is to say, those states most vulnerable to a fuelwood shortage are also those which are least able to pay for alternative forms of energy.

Finally, for the record, it should be noted that a small number of West African states (Nigeria, Ivory Coast, Ghana, Niger and potentially a number of other coastal states) have discovered exploitable quantities of oil or uranium within their national boundaries. However, this fact does not alter significantly the dramatic situation confronting West African nations in the area of household energy in the very near future.

2. Forest Cover: Two questions arise under this topic, "Can alternatives be found to reduce current demands on forests?" and "Is there a way to avoid the environmental damage caused by the destruction of the forest ecosystems?"

The exact nature of the demands currently placed on forests was schematically illustrated on Figure 2 to include essentially (a) slash and burn agriculture, (b) herding practices, (c) household consumption, (d) industrial consumption, and (e) selected ecological factors. The research undertaken for this report was unable to unearth readily available and acceptable West African substitutes for any of the subsistence-oriented requirements (a,b,c). Substitute farming, herding, and energy systems do exist, but either culturally, economically, or technically are not widely acceptable to the people of our region under current conditions.

Alternatives to current industrial forestry demands are not particularly apparent either. World market prices for certain local tropical hardwoods are continuing to climb concommitantly with worldwide demand, especially from the developed world. Plastics, fibreboard and other substitutes cannot replace the qualities of the "noblest" tropical species. It may be possible, however, that West

Table 5 - Energy Utilization in West Africa

Country	Energy Impact Dependence (Imports as % of total commercial energy in 1975)	Exports (Merchandise made in 1976 in US $million)	Energy Imports (as a % of merchandise export earning in 1976)	Total Energy Consumption (1976)		
				Commerical Energy Consumption	Woodfuel Consumption	Wood Consumption (as % of energy)
				(Per capita consumption in kilograms of Coal equivalent)		
Benin	100%	51	43%	49	300	86%
Gambia	100%	( )	( )	84	208	73%
Ghana	78%	804	18%	157	452	74%
Guinea	99%	202	( )	93	260	74%
Guinea Bissau	100%	( )	( )	58	373	87%
Ivory Coast	98%	1620	10%	380	322	46%
Liberia	105%	476	12%	418	474	53%
Mali	97%	97	25%	27	956	97%
Mauritania	99%	178	6%	102	174	63%
Niger	100%	86	( )	35	239	87%
Nigeria	0%	10,567	0%	94	430	82%
Senegal	96%	426	15%	156	265	63%
Sierra Leone	100%	112	10%	112	352	76%
Togo	100%	135	19%	85	173	67%
Upper Volta	100%	53	19%	18	274	94%

Source: Adapted from Howe and Gulick, 1980 (Table IV)

African processing of lower quality wood, especially plywood, may have difficulties competing on the world market (particularly with Asian competitors) because of its high production costs.

Finally, the natural detrimants of forest availability (e.g. rainfall, soil quality) can generally be considered unmodifiable, unless in the form of some program for supplementary care (irrigation or fertilization).

The second question concerning ecologically-acceptable alternatives to forest ecosystems is fraught with speculation. Certainly, some negative effects of deforestation can be partially or wholly resolved through appropriate soil and water management practices (improving grasslands, appropriate farming or herding systems). Destruction of selected types of tropical woodlands will almost certainly lead to the irreversible loss of numerous flora and fauna species. Clearly, destruction of forest cover means for many the destruction of an esthetically vital part of the human habitat. The effect of forest cover on rainfall and climate is less clear, but a number of knowledgeable professionals are predicting disastrous climatic consequences following wholesale destruction of major forest cover, particularly the major tropical rain forest basins in Africa and Brazil.

F. Probable Consequences of Increasing Fuelwood Use and Deforestation Trends:

Unchecked, and lacking alternative solutions, current trends in fuelwood utilization and deforestation will lead West Africa to an extremely precarious and perhaps irreversible position in energy and ecology by the end of this century. This pattern is most evident today in the Sahelian states but could potentially be even more profound in the coastal states in the very near future.

In Senegal, a recent USAID study has indicated that hypothetical consumption of fuelwood alone may exhaust that country's total forest reserves by the year 2000[1]. In relatively well-endowed Guinea Bissau, a recent French-financed study flatly notes that the Guinean forest resources will disappear in less than 20 years unless remedial actions are begun immediately.[2]

Although potentially a useful tool for long-term planning, simple linear extrapolations probably do not paint an accurate picture of long-term scenarios. The fuelwood/deforestation trends which have been discussed herein are indeed serious and potentially catastrophic. It could probably be realistically expected, however, that as pressures

1. Senegal Fuelwood Production PP, 1979
2. GOGB 1980

on forest cover and fuelwood availability mount dramatically, major shifts will take place within the existing development system. An initial shift will conceivably be in the monetary value assigned to fuelwood. To date, many areas, especially rural areas, have considered fuelwood as a "free" commodity, waiting to be harvested. With increased fuelwood scarcity, the value of the product will increase proportionately in monetary and human expenditure terms. In many areas, fuelwood which was previously gathered will soon have to be bought. Shifts could also take place in comsumption patterns. Some may shift to lower-grade, locally-available substitutes such as dried cow-dung or millet stalks. Food intake patterns may change to adapt to a reduced amount of cooking. Or, people may simply migrate, probably from north to south, out of poor savannah areas to the wooded and sparsely populated coastal states such as the Ivory Coast.

This is not meant to be an apology for the gravity of the current situation, nor an excuse for action. Rather, this is meant to inject a certain sense of objectivity into what is, at the present time, a highly emotional issue.

What then can concretely be said about the current trends?

1. Household consumption: At the household level the effects of rapid deforestation will be probably the most obvious and immediate. Those at the lowest income level will clearly be the most affected. For example, inhabitants in Dakar at the lower end of the socio-economic scale were known to spend up to 40% of their family budget on fuelwood in 1975.[1] In Conakry in 1980, this percentage was closer to 20%; in Abidjan in 1978 approximately 20% as well[2]. Changes of price structure over time with steadily growing demand and steadily decreasing availability of supply are difficult to forecast. Shifts in price and demand in Abidjan since 1970 indicate that the "demand elasticity of price" was approximately 2.2 over an eight year period. This means that a 10% increase in demand should lead to a 22% increase in price. If this is representative, and if fuelwood demand were to simply follow demographic trends, we would expect that a 5% growth rate (current urban center representative average) would lead to a 806% increase in fuelwood prices within 20 years. This may be a reasonably conservative estimate as forest reserves will dwindle over time at a rate greater than fuelwood demand alone. It is hard to imagine how the poorest of the urban poor will manage to adapt to this octupling of their everyday energy costs. We would appear to be on the threshold of a major, potentially revolutionary, urban household energy crisis.

1. Universite de Dakar, 1975
2. GOIC, 1975

The rapid disappearance of forest cover around urban areas and the accompanying higher transport costs and spiraling sale price of fuelwood are rampant. Senegal, one of the few West African countries with fairly complete records of fuelwood flows, provides some revealing statistics of this phenomenon, as is graphically illustrated in Figure 3. Available fuelwood resources have already dwindled to the point in that country where 49% of total supply for the Dakar urban area is transported from a distance over 400 Km. and almost 90% from 300 Km. or more. At these distances, transport costs can easily become 30% or more of total production costs.

In Abidjan (situated in the Coastal Zone)transport distances are already often over 50 Km. In Bamako, and Ouagadougou, fuelwood transport distances exceed 100 Km. in many cases and are expecting to increase rapidly over the next few years in the face of rapidly receding forest cover around those population centers. In Freetown, fuelwood supplies may come from distances up to 200 miles.

At the village level, women and children will spend several hours a week in search of fuelwood for daily cooking purposes. In the Sahel it is not uncommon to search 5-10 Km. from the village to locate adequate supplies.[1]

In some of the least forested areas of the Sahel, villages are already known to burn millet stalks as fuel at certain times of the year. Examples of other cultural adaptation due to deforestation are slowly surfacing as well, including, inter alia, reduction in frequency or quality of hot meals,[2] use of plywood boats instead of dugouts, modifications to housing construction, and shifts in pharmaceutical use.

All of these trends can be expected to accelerate over time along with progressive deforestation, although regional differences, especially between coastal and Sahelian states will probably continue to be profound.

2. Industrial consumption: As was noted earlier, log extraction and wood export activities are slowing in all coastal countries except Liberia. The nature of the industry will certainly shift over time, as well, accentuating current trends (a) toward sawn wood exports, away from whole log exports (for greater value added); (b) toward greater use of low-quality

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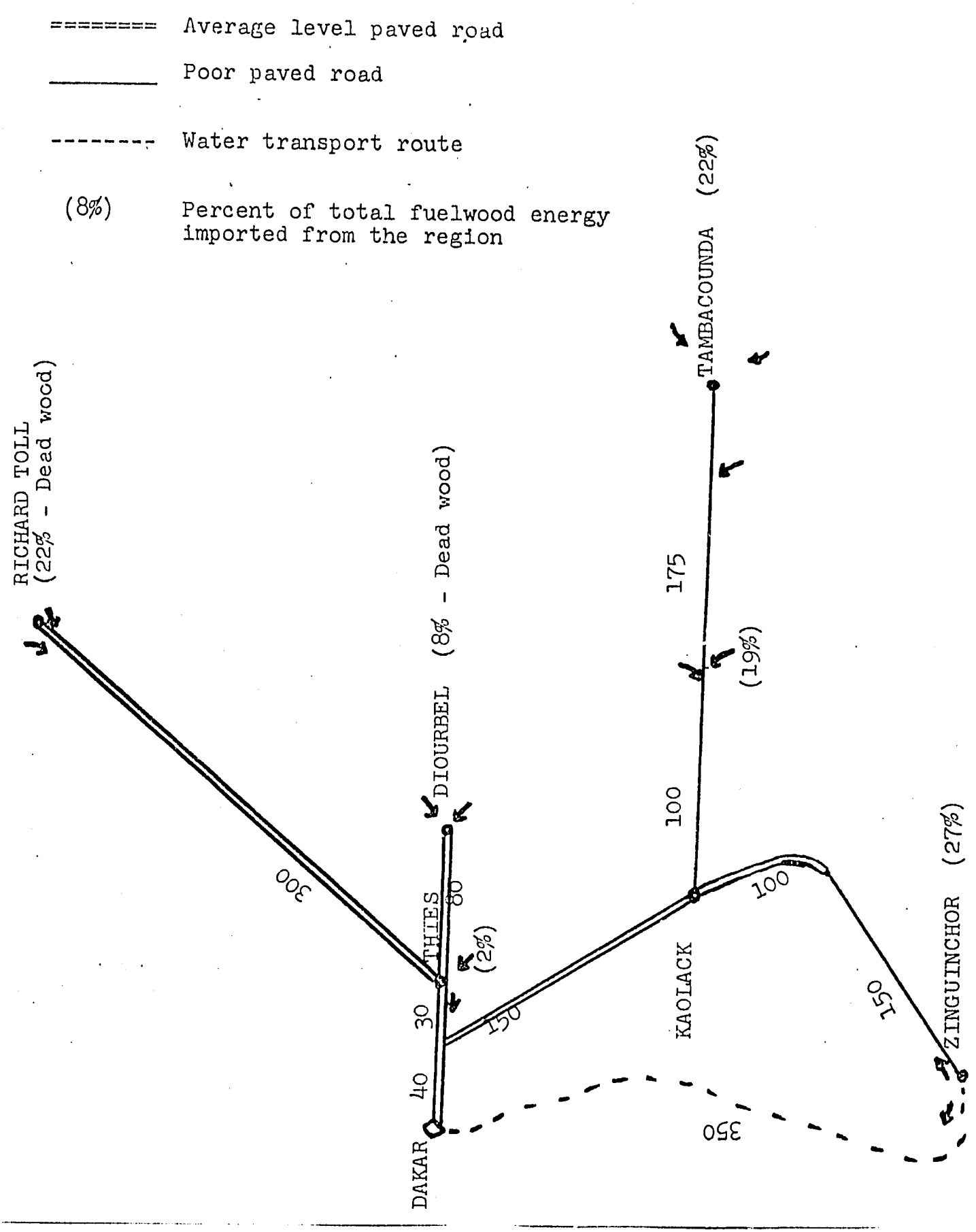
1. It is interesting to note in the well-documented CILSS 1978 energy report for the Sahel (p.43) that, if one assumes that an area has a 25% forest cover, assuming consumption is $.5m^3/p/yr.$, and, finally assuming natural forest production at $.5m^3/ha/hr.$, a region will become deforested if the population density exceeds $25p/Km^2$. This, of course, is already the case for much of the Sahel.

2. Some evidence (e.g.FRIDA, 1980) has indicated that normal meals may be replaced by those with lesser cooking requirements but lower nutrient quality (e.g.To) in cases of fuelwood scarcity.

Figure 3: Representative Transport Distances of Fuelwood Flows to Dakar (1977)



Source: GOS, Water and Forests Service, Rapport Annuel, 1977.

indigenous species and softwoods (pulp production, plywoods); and probably (c) greater proportional marketing in internal and neighboring African markets.

All West African states are at least superficially aware of the theoretical effect of rapid destruction of their tropical forests and appear increasingly to be taking steps to limit it -- including greater efforts at reforestation (albeit generally in lower value species)[1], establishment of natural parks and reserves, and closer regulation of cutting activities.

3. Environmental Consequences: Although perhaps the most profound consequence of deforestation, little of a quantitative nature and indicating causality can be presented today. Water and wind erosion is currently a major problem in West Africa (especially the Sahel), and growing. In the Gambia, annual topsoil loss has estimated at 1/15" under average, relatively flat conditions. In the dry season, winds carry the dusts of the Sahel as far West as the Bahama Islands. Deforestation is not, of course, the only reason for this phenomenon but can certainly be considered an important element of the overall problem.

Likewise, the linkages between tree cover and weather patterns would also appear to be ambiguous. Temperature, and especially rainfall patterns seem to be exhibiting increasingly irregular patterns. Probably the tree has a role to play in this, however specialists are yet not unanimous as to its exact nature.

Whatever the exact consequences of deforestation may be on the environment, all will agree that it is not positive. Phenomena such as irregular and scarce rainfall and ever-accelerating soil erosion will eventually affect all of West Africa's peoples, poor and rich, rural and urban. One is dramatically reminded of the regional environmental relationships within the West Africa sub-region by the startling vision of the dusty Harmattan fog, which settles over humid, tropical Abidjan at the end of every year. The Sahel is blowing away and the whole of West Africa will ultimately suffer the consequences.

II. CURRENT FUELWOOD DEVELOPMENT POLICY AND PROJECTS

The host country and foreign donor response to the fuelwood problem enunciated in the previous section has been timid to date, although receiving much greater lip service the last 1-2 years. Local African governments appear to be only slowly reacting to the recent flood of alarming extrapolations furnished by diverse foreign and local bodies on the related problems of disappearing forest cover, the fuelwood crisis and environmental

1. The most noble West African species will require 50-100 years before arriving at maturity. They are increasingly being replaced with faster growing (5-20 years) varieties (pine and eucalyptus).

degradation. At the governmental level, the fuelwood question is dealt with almost exclusively by the Service of Water and Forests (SWF), which has traditionally been the enfant pauvre of West African bureaucracies, and hence, poorly equipped to deal with either the size or multifacetedness of the problem. To date, local fuelwood strategies, where they exist, have been primarily based on the classic approach of large-scale reforestation. Their ability to implement such a strategy has almost universally been limited to the availability of foreign donor funds. Thus, until the very recent upsurge in foreign donor interest in fuelwood-related projects (particularly in the Sahel), locally-funded reforestation activities seldom exceeded one to two hundred hectares per year in any given West African state. We can probably fairly safely assume, therefore, in all but a few of the richer West African countries (Ivory Coast, Nigeria) that foreign donor investments are fairly representative of overall development investment in the sector.[1]

To better understand the general direction of overall development in fuelwood/forestry, this report has extracted data from two separate sources: (a) a 1980 report by the Overseas Development Council on fuelwood and renewable energies in Africa; and, (b) a USDA Forest Service report 1980, on forestry activities and deforestation in developing countries.[2] Cross-checking of these references indicates some discrepancies between them, so the reader should probably utilize these figures only to indicate orders of magnitude and general trends.

Two basic statements can be made in light of this data (see Tables 6 and 7). First, the total financial resources mobilized for West African forestry-sector activities to date is in the $100 million range (both tables) and probably close to $600-700 million for all renewable energy/forestry activities (Table 7 only). Second, the priority investments (in dollar terms) are heavily oriented to lumpy hydro power projects (75% of total resources), and, of the remaining 25%, most goes into direct reforestation/fuelwood activities (19%), followed by other renewable and institutional energy development (6%).

On paper, at least, current investments strategies in West Africa appear to be characterized by:

-- A basic fuelwood and renewable energy strategy (outside of major hydroelectric projects) which is essentially oriented to reforestation, and, to a much lesser extent, solar energy R&D.

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1. The only major exception to this rule would probably be the private timber interests, who are generally involved in cutting activities only.

2. Howe and Gulick (1980) and USDA (1980)

Table 6: Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)

Forestry activity	Cape Verde	Gambia	Mali	Mauritania	Niger	Senegal	Upper Volta	Sahel Regional	TOTAL
Industrial:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	--	--	--	--	--
Proposed	--	--	7,091	--	--	--	--	--	7,091
Conservation:									
Completed	--	20	--	7	520	4	--	--	551
Ongoing	4,518	--	--	8,561	2,636	15,850	5,343	--	36,908
Proposed	1,116	--	16,926	10,415	4,439	2,320	2,500	--	37,716
Education:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	355	300	300	2,635	3,075	6,665
Proposed	97	--	600	--	--	1,696	--	2,210	4,603
Research:									
Completed	--	--	270	--	--	--	--	--	270
Ongoing	--	--	190	38	141	--	--	--	369
Proposed	124	--	--	--	--	--	--	4,150	4,274
Reforestation/ afforestation:									
Completed	--	--	--	--	--	--	3,500	--	3,500
Ongoing	9,885	--	2,674	6,021	3,115	2,658	5,281	--	29,634
Proposed	--	2,500	10,410	10,000	2,842	5,041	--	--	30,793
Integrated development:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	262	1,292	--	--	1,554
Proposed	--	1,500	--	--	1,772	18,669	--	--	21,941
Technical/ administrative/ management assistance:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	--	--	--	--	--
Proposed	--	--	--	--	--	--	--	--	--
Total Sahel West Africa									
Completed	--	20	270	7	520	4	3,500	--	4,321
Ongoing	14,403	--	2,864	14,937	6,454	20,100	13,259	3,075	75,130
Proposed	1,337	4,000	35,027	20,415	9,053	27,726	2,500	6,360	106,418
									185,869

Contd.

Table 6: Contd.

Forest activity	Benin	Ghana	Guinea	Ivory Coast	Liberia	Nigeria	Sierra Leone	Togo	Total
Industrial:									
Completed	29	--	--	--	815	--	173	--	1,017
Ongoing	592	2,404	--	--	9,600	--	--	--	12,596
Proposed	1,100	--	--	--	--	--	--	--	1,100
Conservation:									
Completed	--	--	--	--	--	44	--	--	44
Ongoing	674	25	--	--	6	151	--	--	856
Proposed	--	--	--	--	--	--	--	--	--
Education:									
Completed	--	--	659	--	823	334	3	--	1,819
Ongoing	--	--	--	--	--	677	--	--	677
Proposed	--	--	--	--	--	--	--	--	--
Research:									
Completed	--	--	--	--	--	242	--	--	242
Ongoing	--	280	--	3,400	--	1,370	--	--	5,050
Proposed	--	--	--	--	--	--	--	--	--
Reforestation/ afforestation:									
Completed	--	--	--	--	--	124	--	--	124
Ongoing	--	--	--	--	--	400	--	501	901
Proposed	--	--	300	54,400	--	--	--	--	54,700
Integrated development:									
Completed	--	--	--	--	330	1,691	--	--	2,021
Ongoing	--	--	--	--	--	--	--	--	--
Proposed	--	--	--	--	--	3,965	10,100	--	14,065
Technical/ administrative management assistance:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	165	1,004	72	--	1,241
Proposed	--	--	2,000	--	--	659	--	--	2,659
Total: Non-Sahel West Africa									
Completed	29	--	659	--	1,968	2,435	176	--	5,267
Ongoing	1,266	2,709	--	3,400	9,771	3,610	72	501	21,321
Proposed	1,100	--	2,300	54,400	--	4,624	10,100	--	72,524

Table 7: Inventory of Current Assistance Programs Related To Fuelwood in West Africa by Country and Category (000 US$)

Country	Hydro Power	Reforestation	Fuelwood	Solar	Other Renewable	Timber Industry	Institutional Development	Total
Benin	31	50		27				108
Cape Verde					803			803
Gambia		2,720	20				250	2,990
Ghana	306,385		3,027	540		1,300		311,252
Guinea	1,100		500	200				1,800
Guinea Bissau							361	361
Ivory Coast		18,000			375			18,375
Liberia		11,350				1,350		12,700
Mali	178,100	105	5,510	8,677			1,180	193,572
Mauritania			700	724			4,360	5,784
Niger	3,244	774	4,600	3,352			2,394	14,364
Nigeria		400	31,230			250	290	32,170
Senegal		11,380	3,399	5,978			15	20,772
Sierra Leone	2,963			000				10,963
Togo								---
Upper Volta		12,320	12,303	684	56		4,200	29,563
Total	491,823	57,099	61,289	28,182	1,234	2,900	13,050	655,577

Source: Howe and Guilick. 1980

-- A major emphasis in locating fuelwood and renewable energy activities geographically in the Sahelian States.

-- Fairly modest commitments to the non-hydro aspects of renewable energy development, averaging perhaps $1-2 million per year per country over the total West African region.

The USAID Response: USAID interest in this sector in West Africa grew initially out of its concerns for environmental degradation in the Sahelian region in the mid-1970's. In the last five years and particularly through the CILSS coordinating mechanism, USAID has come to target the fuelwood sector as a priority area for involvement. Table 8, attached, indicates total USG programmed investment in the sector at some $27 million, although much, as of this date, is in its very earliest stages of implementation, and, often, only there, under considerable difficulty. Based on this recapitulation, virtually all of this sum (98%) is destined for the Sahel states. A rough breakdown of investment by activity indicates priorities in direct reforestation (52%), support for national forestry or resource management (27%), and solar or other non-fuelwood renewable energies (22%).

Current USAID policy is heavily oriented to forestry activities and is secondarily concerned with solar and other non-fuelwood alternatives. In the fuelwood area, general policy appears particularly directed to the "village woodlots" project proposals, often through the intermediary of a PVO. Recently, increasing interest has been focused on experimentation with improved household cookstoves. Despite USAID's basic emphasis on reforestation, less than 5,000 hectares are currently programmed for development through AID funds and only a few hundred have actually been planted to date.

III. CONCLUSIONS AND OBSERVATIONS FOR THE FUTURE.

The ultimate objective of this discussion paper is to arrive at concrete suggestions for action which can be undertaken by USAID in light of its current policy orientations and which are realistically feasible, given the current local context. A number of those suggestions follow, based on REDSO/WA field experience and observations from within the West African Subregion.

A. The integrated perspective: Taken in a larger systematic perspective, the fuelwood problem is one which is ultimately linked to wide variety of actors and actions (total forest utilization, agriculture and herding systems, population, energy, environment). A comprehensive scheme for dealing with the fuelwood crisis can and should address the problem from this larger perspective and should associate itself with a variety of host country and foreign donor initiatives.

Section II of this paper has indicated that the host country and foreign donor response to the fuelwood question has been largely focused on reforestation as a generalized panacea. If one accepts the logic developed in Section I, however, this

Table 8: USAID Cumulative Assistance to Fuelwood and Other Renewable Energies in West Africa

Country	Amount ($000)	Description
1. Cape Verde	500	Renewable Energy AIP (625-0937.03)
2. The Gambia	1575	Reforestation (635-0205)
3. Guinea	500	Community Forestry AIP (698-0410.35)
4. Ghana	108	Pyrolytic Converter
5. Mali	495	Village Reforestation (625-0937.09)
	4094	Renewable Energy (688-0217)
	220	Solar Pump (Operation Mils) (688-0202)
6. Mauritania	4350	Renewable Resources Mgmt. (682-0205)
	300	Firewood and Reforestation
	400	Fuelwood, Dune Stabilization
7. Niger	671 (?)	Niamey Integ. Development Reforestation (683-0205)
	4000	Forestry and Land Use Planning
	500	Solar Energy Development (683-0247)
8. Senegal	175	AFRICARE Village Woodlot (685-0247)
	3134	Fuelwood Production (685-0219)
	831	SODESP Well Reforestation (685-0224)
	700	Solar Pump (685-0208)
	300	Renewable Energy AIP (685-0238)
9. Togo	50	Solar Energy IRT (698-0410.13)
10. Upper Volta	(?)	Seguenega IRD with Forestry Component (686-0231)
	4200	Forestry Ed. & Devel. (686-0235)
	80	Tangaye Solar Grain Mill & Pump (698-0410.13)
Est. Total	27,403	

Source: Howe and Gulick, 1980 and USAID Annual Budget Submissions

response would appear to be only partial and almost certainly not a highly effective use of the human and financial resources which are available to the sector, given the intersectoral nature of the problem.

Widespread reforestation alone, if one is to expect reasonably high rates of seedling survival, has consistently proven to be an expensive proposal in West Africa, most frequently around $1,000 per hectare (approximately $400/acre). Furthermore, reforestation in the region requires considerable logistic support and local management, and, under the best of conditions, will yield mature trees only after 5-10 years (carefully supervised plantations). Sahelo-Sudanian natural forests usually require a minimum 20 years, and the "nobler" coastal zone species 50-100 years, to attain maturity. For those who plant the trees, therefore, tangible benefits are slow in coming, be they for household consumption or monetary gain. Environmentally, of course, the positive aspects of reforestation are also evident only in a long-term perspective.

This weak linkage between the action of reforesting and the planter's realization of any form of immediate, concrete gain is probably one of the major obstacles to effective development of "village woodlots" or "community forestry" proposals in our area. Because reforestation actions are often perceived by villages to be long-term, and therefore marginal in importance to more immediate tasks, traditional community forestry projects are often relegated to marginal lands (low productivity lands and hence even poorer yields) and to poor maintenance performance (weeding, watering, protection from fire, or predators) by villagers whose labor requirements are already stretched to the limit by the demands of subsistence agriculture, or herding systems.

This paper would recommend that USAID policy in the fuelwood (and general forestry) sector broaden considerably its framework for action and go beyond the fairly limited proposals for "widespread reforestation" and "village woodlots" in order to more efficiently utilize our limited financial and human resources, encourage greater host country awareness of the overall problem, and hence, make a more consequential impact on not only the fuelwood situation in West Africa, but also those sectors (environment, energy, agriculture, livestock, general forestry) which are intimately linked to it.

Because of the necessity to move forward on many fronts, a bit of reflection on the order of priority of USAID investments in those actions would seem appropriate.

The following indicative list has been drawn up according to regional observations to reflect those investments which are responsive to current AID policy objectives and which appear feasible and desirable in both an immediate and long-range (5-20 years) time frame.

(1) Immediate USAID investment proposal: (Currently feasible technically, socially, economically and with rapid impacts or providing essential foundation for future development in sector)

- -- Urban fuelwood plantations.
- -- Encourage population strategies which take into consideration global man - natural resources (including forests) relationships.
- -- Institution building through training in forestry and resource management (especially low and mid-level personnel) and development of national planning and analysis capability in forestry and resource management.
- -- Front-line reforestation (sand dune fixation, reclamation of marginal lands, watershed management).
- -- Forestry add-ons to proposed and existing IRD schemes
- -- Pilot projects and research in:
  - a. appropriate (non-fuelwood) renewable energies.[1]
  - b. community forestry.
  - c. improved cooking methods (cookstove and food processing).
  - d. improved local forestry techniques to reduce nursery, plantation and maintenance costs while improving yields.
  - e. improved charcoal conversion and marketing.
  - f. agro-forestry.
  - g. sylvo-pastoral.
  - h. improved fire protection and management.

(2) Medium and long-term investment proposal:

(not currently proven feasible or easily replicable but with long-term promise)

- -- Major village-level fuelwood reforestation.
- -- Major extension of appropriate alternative household energy systems, agro-forestry, sylvo-pastoral and general resource management schemes as well as improved charcoal techniques noted above.

It should be noted that the final emphasis of the program response suggested in this report will vary with the forest zone in which one is working. It would seem fairly clear, for example, that Sahelo-Sudanian Zone activities would be more oriented to fuelwood production and farmland/pastureland management, whereas those in the Coastal Zone would focus more on slash-and-burn agriculture, industrial forestry and the danger of rainforest destruction.

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1. Appropriate renewable energy research in our sub-region should be accelerated and experimented with in a wide range of USAID projects. The REDSO/WA Energy Task Force will make more specific statements on those which appear best suited to our area, tentatively including solar, mini-hydro alcohol production, and utilization of organic wastes (briquettes, biogas).

It would seem realistic and desirable for USAID to think in terms of investments totaling $50-60 million for the West African states alone over the next five years in data collection and field experiments (research, pilot projects), institution building (training, host country capabilities), critical reforestation and urban fuelwood production.

Finally, it should be emphasized that the fuelwood problem, as is true of numerous development issues in our subregion, is complex and intimately related to a host of non-fuelwood development concerns. Not only should USAID be attempting to develop policies for this and other issues on the basis of integrated analysis, but, furthermore, it should actively seek out and employ direct-hire analysts who have a broad enough field experience to permit them to utilize such an integrated approach.

B. Urban Fuelwood Needs: At the risk of running counter to the mainstream of current USAID thought in this sector, this paper concludes that one of the current priority areas for Agency project involvement should be in response to fuelwood requirements for the urban areas of West Africa. The reasons behind this conclusion seem clear in light of the Section I presentation, and include the fact that:

-- urban fuelwood requirements are already substantial and growing at a rate several times that of most rural areas, and,

-- unlike rural consumption, that of urban areas is spatially concentrated, highly monetarized and reasonably organized -- all characteristics which permit host country governments and foreign donors alike to more easily deal with the problem in the context of their habitual project operations.

Although Sahelo-Sudanian and Coastal Zones could usefully address the question of urban fuelwood supply today, the most pressing need to develop such a strategy would appear to be in the former. Specific projects amenable to USAID financing in the areas include fuelwood plantations, improved charcoal conversion, and improved wood and charcoal cookers.

(1) Fuelwood plantations: Appropriately designed and supervised energy plantation projects can generally be located within 50 kilometers of the urban agglomeration (depending on land availability) and can offer:

-- considerable savings in transport costs
-- greater reliability in supply to urban users
-- potential recreation or leisure zones and/or useful setting for agricultural or pastoral associations close to the urban area.

One of the most significant attempts to date in this direction is a USAID/Senegal project[1] to produce 3,000 hectares of fast-growing exotic and indigenous species in order to service the fuelwood needs of the Dakar-Thies urban area. If successfully implemented, the project will yield as much as 5% of total national marketed consumption of fuelwood and simultaneously spare an estimated equivalent 60-150,000 hectares of upcountry natural forest cover which normally would be harvested to service that demand. Of particular interest to those concerned with replication of similar schemes elsewhere in Senegal or the Sahel, this project includes some $400,000 for one of USAID's most comprehensive forestry research proposals to date. Trials are being coordinated by the Senegalese Service of Water and Forests and the Forestry Research Center (CNRF) around four themes:

-- reduction of production, plantation and maintenance costs,

-- eight upcountry experimental sites to determine forestry potential of Senegalese soils and climates,

-- evolution of soils under eucalyptus plantations,

-- water balance study of forest plantations.

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1. Senegal Fuelwood Production (685-0219). The result of several years of careful research by the Senegalese Forestry Research Center (CNRF), the project is now in its second year. Total funding is $3.9 million. Anticipated average yield is on the order of $10m^3$/ha/yr. for eucalyptus camaldulensis and slightly less for other species. Initial harvests are expected five years after plantation and should be repeated several times from the same stump due to coppicing. The GOS Forest Service is responsible for fuelwood production. Harvesting and marketing will be the task of local woodcutters and charcoal makers and recurrent costs for the project should be covered by the sale of cutting rights to these entrepreneurs. Under normal conditions, each hectare planted under the project should produce the charcoal equivalent of 20-30 hectares of upcountry natural forest. If successful, a follow-one on Phase II will bring total production to 6,000 hectares potentially taking pressure off 120-300,000 ha. of upcountry natural forest.

This research should provide foresters across the Sahel with useful new data on low-cost, labor-intensive techniques (nursery, planting and maintenance), and the long-term affect of intensive reforestation on soils and the water table. Proposals have also been advanced to utilize the critical human and financial mass attracted by the project on related forestry extension and research to the village-level as well although, to date, no action has been taken in this regard.

Similar schemes could easily be developed (and in some cases are) around other major Sahelian cities, particularly Bamako, Ouagadougou and Niamey, and potentially, Praia and Nouakchott. Also of real current potential but no longer eligible for USAID funds are a number of Nigerian urban centers, both on the coast and upcountry (e.g. Lagos, Kano, Sokoto) where heavy population pressures are decimating local forests. Final screening of priority sites would require more careful study of population, consumption, forest cover and marketing patterns than has been undertaken in this report, however.

(2) Improved charcoal conversion: The rapid growth of West African urban areas and the accompanying greater demand for charcoal would seem to dictate the need to improve upon current wasteful charcoal conversion practices. As has been noted previously, traditional charcoal yields are often only 10-15% of the dry weight of the wood and at most attain only 20%. A project promoting extremely simple, low-cost and portable improvements such as the fourneau casamancais, noted earlier, could conceivably produce as much as 30% of dry weight, and 50% faster.

Charcoal production in West Africa is carried out by a fairly small number of individuals specialized in the art. They are generally illiterate, highly mobile, work under semi-clandistine circumstances, and often not nationals of the country in which they work. These characteristics render them illusive targets for improvement projects in their natural setting upcountry. The urban fuelwood plantation project setting noted above probably provides an excellent opportunity to overcome these obstacles and extend a new technology and teach improved methods to traditional charcoal producers under carefully monitored conditions.

(3) Improved fuelwood cookers: Urban areas represent probably the best terrain for experimentation with improved fuelwood cookers. At least four consequential ongoing efforts in the West Africa region are currently known to REDSO/WA staff (Accra, Ouagadougou, Dakar, Niamey) and essentially deal with the introduction of lorena-type stoves for firewood consumption. None appear to have led to

proven conclusive results to date and problems have been noted in household acceptance as well as technical insufficiencies related to selection of local materials. No local experimentation on improved charcoal cookers has been discovered to date.

On this topic, it would seem appropriate to set the record straight by first undertaking reliable and representative measurements of energy use and energy waste associated with the commonly utilized cooking methods in West Africa. Certainly local measurements of efficiency should be a prerequisite to the development of specific cookstove projects in our area. A number of opinions on the topic have been registered, but few appear to be backed by solid field data. The three-stone cooker system is often cited as being outrageously inefficient, utilizing only 5-10% of the energy potential of the firewood. Lacking accurate data it is hard to judge the validity of such estimates, but one cannot help but wonder whey the normally intuitive West African villager would continue to calmly waste such an enormous part of his vital firewood energy supply. It is often noted in villages, for example, that firewood is generally not abusively piled up under the cooking pot. The flame is often expertly focused on the bottom of the kettle and the wood is only slowly and progressively introduced into the center. In case of winds, the fires are often protected by some form of windbreak, and, occasionally are even utilized inside the hut for protection. When perceived as necessary in the local context, specialized cookers have occasionally been developed by motivated villagers, e.g., the simple, portable pottery model developed in densely populated Southern Benin, or as in the Sahel, a special clay cooker for millet beer production.

It would seem appropriate, therefore, to first study the efficiency of existing local methods, both firewood and charcoal. If clear improvements appear possible, then attempts should be made to adapt, at least in the early stages, existing methods in ways socially and economically appropriate to those who will use them.[1]

In the urban setting, REDSO/WA is currently exploring ways which appropriate cookstove design might be incorporated into USAID (RHUDO) low-income housing projects in our area. Hopefully more will be done in this area in the future.

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1. Probably the most promising work undertaken to date in the West Africa region is in Upper Volta, where German aid and VITA (Volunteers in Technical Assistance) have been actively involved for the last several years. A good recapitulation of their efforts may be found in Gern, Jacobs and Evans: 1980.

(4) Improved Fuelwood Marketing: The commercial marketing of fuelwood is, to date, a fairly unorganized, ad hoc and practically clandestine sector of activity. Fuelwood agents move into areas of reasonable access and fuelwood availability in a coincidental fashion, and transport their produce to market equally as informally -- generally catching a ride and negotiating the tariff on the roadside with trucks passing by with an empty return. One might argue that it is precisely this unstructured approach which keeps market prices low. Although this may be, at least in part true, it would also seem plausible that improved organization of fuelwood marketing, especially for major demand areas, could lead to more regular supply (hence reduced seasonality of prices for the consumer), more efficient utilization of available dead wood supplies, and potentially, less destruction of live forest cover in areas where it serves a critical environmental role. Information on this important topic, is highly incomplete. This paper would only suggest, therefore, that it should be examined carefully, along with other fuelwood topics in order to formulate appropriate policies for future developments in the sector.

C. Rural Fuelwood Needs: Although this paper has downplayed the immediate role that USAID might play in village-level forestry, it is not felt unreasonable to assume that a large part of the long-term solution to current deforestation trends may lie with the rural populations of West Africa. Traditional land tenure rights and the ultimate necessity for West Africans to better manage their total natural resource base makes village populations clear candidates for major rural reforestation effort. Nevertheless, as we move progressively from a theoretical, long-term framework to one of localized field experience, REDSO/WA has become increasingly aware of a number of implementation realities which constrain considerably ambitious plans in this sector, notably,

1. "Community forestry" is generally more than "village woodlots". Local perceptions of forestry needs are frequently more complex than those of simply producing fuelwood over a fairly long timeframe. To incite local interest in local forestry requires a localized understanding of felt needs and the evolution of simple, inexpensive and low-maintenance techniques to achieve them rapidly.

2. Community forestry probably only succeeds where local political organization is geared to manage it (planning, planting, maintenance and distribution of benefits). Experience to date has shown that West African villages simply do not easily lend themselves to such a management effort unless closely supervised and assisted by outsiders. As most Water and Forest Services in our areas are not currently well-equipped to undertake this type of decentralized role, the relatively few success stories observed by REDSO/WA to date have generally depended considerably on expatriate volunteer or PVO groups such as

Peace Corps or CARE.

Because of the fairly experimental and highly localized nature of community forestry schemes in West Africa, it is suggested that USAID, as an organization, is probably not well-equipped structurally to deal with this type of activity. USAID funds can and should be utilized in this sector, but probably should basically be channeled through Peace Corps, competent PVO's, or as a sub-part of a large general forestry or rural development scheme.

Pilot efforts in community forestry, especially in integrated forestry, (agro-pastoral forestry) should be vigorously pursued and documented, but it seems highly unlikely that large sums of USG funds could be currently funneled into the sector with any reasonable expectation of widespread, tangible results. Paradoxically enough, because of the multiplier effect of carefully supervised urban fuelwood plantations (one hectare of urban plantation can spare 60 or more hectares of up-country natural forest in the Sahel) focusing today on urban fuelwood needs will probably have a greater immediate impact on rural fuelwood needs than would a direct, large-scale, village-oriented approach.

One promising example of an innovative attempt at integrated community forestry in the REDSO/WA sub-region is the Guinea Bissau Forestry Project (USAID Project Number 657-0005). That project is a $5.6 million SIDA/GOGB/USAID/SUCO effort to refocus forestry management to the village level in Zone I of Guinea Bissau and will take advantage of that country's village-level political orientation to develop forestry activities best suited to the different needs of local community groups. The individual interventions will be extended progressively and will necessarily evolve considerably through a feed-back/evaluation mechanism set up under the project to monitor the localized socio-economic and physical constraints of forestry development. The interested reader is encouraged to examine the PP proposal for details.

D. Regional Relationships: As a regional organization REDSO/WA often focuses on the regional implications of USAID policy. The fuelwood/forestry issue is no exception to this rule and at least three observations of a regional nature could be made in the context of this report.

First, it has seemed clear to the Sahelian states and foreign donors for some time that a Sahel-wide collaboration and information sharing in the forestry and energy areas is highly desirable, given the common development interests of the Sahelian countries as well as the fairly homogeneous physical and climatic characteristics which they all manifest.

Their coordination mechanism is, of course, the CILSS, particularly through its standing committee on forestry and ecology. As the energy crisis continues to place a substantial burden on the developing economies of West Africa and as the regional trends toward deforestation and population growth accentuate, other regionally-oriented bodies such as ECOWAS, CEAO, AFDB, CADA and the Entente Fund are proposing their own investigation of certain themes touched upon in this report. The opportunities for USG collaboration with these regional West African entities could be expected to grow. It is suggested that REDSO/WA, given its regional geographical focus and its wide spread of technical skills, could play an important role in monitoring and directing any regional coordination between AID/W and the field in the fuelwood, energy and forestry areas.

Secondly, on a regional basis, West Africa exhibits two basic types of forest cover, as was noted at the outset of this paper. Given these radical intra-regional disparities, it would seem only logical to think, on a long-term basis, of ways which mutually advantageous forest resource transfers between the zones could take place. In the commercial arena, for example, a large portion of the Sahelo-Sudanian Zone's requirements in sawn wood are already furnished by the Coastal states. This trend can be expected to continue. It would seem useful to broaden this tendency by promoting, as soon as feasible, trade in fuelwood from the forested areas of the South to the energy-scarce cities of the Sahel. Because of the long distances involved, low-cost transport will surely be a key factor in such a proposal. Routes currently estimated by REDSO/WA to be at the threshhold of feasibility include maritime transport from Guinea Bissau to Praia, rail transport from Southern Ivory Coast to Bobo and Ouagadougou and road transport from Western Ivory Coast and Liberia to Bamako[1]. In its early stages, such a traffic would probably be undertaken exclusively in charcoal becuase of lower transport costs. The Entente Fund, however, is currently studying the possibility of pelletizing agricultural wastes in the Ivory Coast and could eventually attempt to market part of their production in the Sahelian states. Properly developed and managed, it may be currently possible for special energy plantations in Guinea Bissau to ship firewood to Cape Verde. It should be expected that the market for coastal fuelwood in the Sahel will become progressively more attractive as the fuelwood scarcity drives up prices (particularly in the urban areas).

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1. The road was recently paved on the Ivory Coast side to Odienne and is proposed for construction to Bougouni and Bamako on the Mali side.

Thirdly, as noted in Section I, environmental linkages exist between the major ecological zones of our subregion. At a minimum, it would seem useful for USAID to utilize the direct-hire and contract expertise located in REDSO/WA[1] to furnish AID/W and local field missions with informed analysis and suggestions for program and project development in the complex field which is clearly larger than the national boundaries of individual African states. This, of course, goes beyond the sectoral topic of fuelwood and forest cover, but must be analyzed if we are ever to fully understand the ecological implications of our development investments in the area.

E. Funding and AID Long-Term Commitment: If one can believe the plethora of materials (guidance cables, airgrams, evaluations, special papers and reports) the topics of energy, forestry and environment would appear to be three of the most fertile areas for AID involvement in West Africa, coming perhaps second in overall importance only to food production. These three topics, when funneled through our basic concerns for the poor majority clearly lead the interested observer to focus on the fuelwood question. If we wish to make a meaningful impact on these sectors in West Africa, we should be prepared to:

1. Undertake analysis and develop projects and strategies in an integrated fashion and based on field experience of in-house professionals. This implies the development of appropriate professional skills within the Agency (both in AID/W and the field) as well as a greater integration of forestry, energy and ecology concepts into existing technical divisions and staff.

2. Invest more in the fuelwood/energy/forestry/ecology area (earmarking of perhpas $50 million over the five years and $200-300 million over the next 20 years would seem reasonable) and make long-term commitments to follow through over time to the extent this would be viewed desirable by future host-country and USAID evaluations.

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1. REDSO/WA has an Energy Task Force which is actively focusing on the energy question in our subregion in an integrated fashion. REDSO/WA currently has local technical expertise in energy technology, resource management/ecology, forestry, development economics, development anthropology, population, health, human resources, agronomy, etc.

3. Work closely with other donors, professional groups, host country governments and among ourselves, to share information and more efficiently focus overall human and financial resources on the priority issues to be confronted in our local context.

That effort has yet to be prepared.

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