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**DEPARTMENT OF STATE**

PN-AAH-765  
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FROM - AID/W

E.O. 11652 N/A

SUBJECT - The Firewood Problem in Africa: Report on the AFR Firewood Conference and Request for Field Views

REFERENCE -

At the request and with financial assistance of the Bureau for Africa, the Overseas Development Council organized a Firewood Workshop, June 12-14. More than 30 persons were present throughout, representing AID, the World Bank, Africare, the Department of Energy, the Peace Corps, the Department of Agriculture, the National Academy of Sciences, VITA, the al Dir'Iyyah Institute, and the Overseas Development Council, along with several universities and private consulting groups. In addition, several Congressional staffers and four African foresters in Washington on an ICA travel grant attended the Workshop's opening session. Discussions of the Workshop were guided by the working paper that David French had prepared for the meeting (attachment D). A complete list of participants is included as Attachment A.

A. Conclusions

The Workshop ended with strong agreement on three summary points:

1. Situation. Firewood and charcoal are becoming less available and more expensive throughout Africa, presenting an immediate threat to the well-being of both rural and urban poor.

2. Knowledge. Unfortunately, there remain conspicuous gaps in our knowledge of the firewood situation, making it difficult to plan effective projects or for African governments to formulate responsive policies. Especially acute is the lack of information on such questions as villagers' perceptions of the problem; appropriate tree species for projects in the Sahel; availability of local institutions to manage village woodlots; and present efficiencies of wood use, given current techniques of cooking and charcoal-making.

| DATE                      | OFFICE                 | FILE NO.                     | DATE      | APPROVED BY           |
|---------------------------|------------------------|------------------------------|-----------|-----------------------|
| JBlumgart:cae             | AFR/DR/SDP             | 21808                        | 8-22-1978 | <i>Robert Butcher</i> |
| AFR/DR:JKoehring (Subs)   | AFR/EA:HJohnson (Subs) | AFR/RA:DConroy (Info)        |           |                       |
| AFR/SFWA:DShear (Subs)    | AFR/SA:TQuimby (Subs)  | AFR/DP:CWard (Info)          |           |                       |
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3. Action. While gathering of basic information is essential, not all firewood activities need wait until this process is completed. Given the urgency of the situation, attention might immediately be given to local testing of wood stoves, pilot experiments with village woodlots, and other activities for which a clear need now exists in particular countries.

B. Follow Up

I have reviewed the proceedings and recommendations of the workshop and believe they constitute an important and valuable beginning toward greater concern and program emphasis, within the Bureau, as they relate to this problem. For this reason, I am transmitting to you a summary report on the Workshop (Attachment B) and request that all missions initiate, in conjunction with host governments, consideration of firewood activities and projects as part of our bilateral programs. Specifically, I encourage Missions to consider:

- inclusion of firewood components (e.g. village woodlots) in rural development projects already being prepared;
- support for local experiments with improved wood stoves and charcoal kilns (small grants for this purpose could be made available quickly through the Improved Rural Technology project managed by AFR/RA);
- initiation of talks with officials from forestry and extension services, energy agencies, etc., in order to consider new projects ranging from large-scale firewood plantations near urban areas to national programs in support of village woodlots;
- initiation of discussions with policy-level officials as to steps that local governments might take, with AFR assistance if appropriate, to alleviate the problem or to heighten popular consciousness of the severity of the problem;
- participation in the firewood study outlined below.

Firewood Study . To assist our Missions in considering firewood activities, I propose that AFR contract for a firewood study to be carried out in approximately six countries. ( A draft scope of work is included as Attachment C). In each country, purposes of the study would be to:

- establish local networks of people and organizations concerned with firewood issues;
- collect basic data necessary to understand the dimensions and nature of the problem in various areas;
- use these data as the basis for conferences and discussion among interested officials and organizations within the country on next steps to be taken including, whenever possible, preparation of PIDs for AID/W review.

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**C. Action Requested**

Missions are requested to:

1. Review the attached materials and share their findings and conclusions with host country agencies and appropriate policy officials;
2. Provide comments by mission and host governments of the problem as perceived from the field and the validity of the approach recommended in this message. Suggestions for increasing the effectiveness of the approach, or tailoring it to local circumstances, are highly welcomed.

Indicate activities, projects or policy measures which the mission proposes to undertake, or encourage the host government to undertake, in accordance with the suggestions outlined under "Follow Up" above.

Comment in particular on the scope and methodology of the study proposed in Attachment C, and its budget, including such changes as you may feel will contribute to its value. Specifically, mission should indicate their and host governments' interest in participating in the study and the local institutions that would be primarily involved.

I request that you prepare your responses so that they will be received in Washington no later than October 15. Please head them: "For AFR/DR/SDP."

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ATTACHMENT A

PARTICIPANTS IN AFRICA BUREAU FIREWOOD WORKSHOP

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ATTACHMENT B

SUMMARY OF PROCEEDINGS, AFRICA BUREAU FIREWOOD WORKSHOP

12-14 JUNE 1978

Summarized below are major conclusions of the Africa Bureau Firewood Workshop. Proceedings closely followed the organization of material in David French's background paper, which served as the basis for discussion throughout the meeting.

I. ISSUES

A. Vanishing Firewood

1. Patterns of Loss. Participants agreed that firewood and charcoal generally are becoming less available and more expensive throughout Africa. Even within a given country, however, the situation may vary greatly from area to area. Unfortunately, detailed information is almost everywhere unavailable. There is an urgent need to collect data on patterns of deforestation.

2. Reasons for Loss. The depletion of firewood reserves has a number of causes, including: clearing of land for agricultural settlement; urbanization; increased petroleum prices (reversing the shift from wood to kerosene and other "modern" fuels); grazing of animals in marginal ecological zones; drought. Again, we have little information on which of these factors are dominant in particular areas.

3. Local Perceptions. So far, we have largely dealt with firewood from our own perceptions of the problem. There is great need to determine what local perceptions are in areas where firewood projects may take place. A variety of methods for doing this were discussed, including local surveys by Peace Corps Volunteers and/or PVOs and the use of established videotape techniques for probing perceptions of villagers themselves. There was general agreement that further exploration of such methods is extremely important.

Also important is to determine governmental perceptions. Measured by resources committed, African governments historically have accorded a modest priority to forestry, and practically none in firewood. Before proceeding further in particular countries, we need to know whether firewood is now perceived by national planners as a serious problem to which serious attention will be given.

B. Patterns of Acquisition and Use

We have little information about how energy actually gets from tree to cooking fuel in specific areas. Major questions to which we need answers for effective firewood programming include: Do people now gather (or make) their

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SUMMARY OF PROCEEDINGS, AFRICA BUREAU FIREWOOD WORKSHOP (cont'd)

own supplies of wood (or charcoal), or do they rely on traders? How much fuel do people actually use throughout the year? How efficiently is wood used, whether burned directly or converted to charcoal? What would be the effect of new projects on these patterns of fuel use?

A further area of inquiry is the extent to which dung or agricultural wastes such as millet stalks are currently used for fuel. Limited evidence suggests that use of these materials is itself symptomatic of a "firewood problem", since people generally prefer wood to such fuels where wood is available.

C. Strategies: Management of Existing Forest Resources

Although not sufficient in itself, management of existing vegetation should often be a central element within national firewood programs. This is especially true in areas of the Sahel where remaining woodlands or brush are under severe pressure.

D. Strategies: Planting Trees

There is little history in Africa of tree-planting activities for the explicit purpose of providing firewood (as opposed, for example, to planting for timber or export). In fair degree, experience in this area will have to be accumulated as we go along.

1. Areas for Planting. Places where trees should be planted will depend on need, growth potential, and alternative uses of land. In most cases, adequate information on these subjects does not now exist. Before major firewood programs can be undertaken, careful data-gathering will be required to determine the specific areas most appropriate for planting.

2. Tree Species. Since the experts remain uncertain about tree species appropriate for firewood projects in the Sahel, local research into the performance of various species is urgently required. Knowledge of tree species for other climate zones in Africa is more complete.

3. Project Scale. Large-scale firewood plantations are urgently required to meet fuel needs of people in urban areas, especially in Sahelian countries. With proper management, such projects could sustain yields adequate to provide wood for up to five people per hectare planted.

Village woodlots are more appropriate for rural areas, although careful social investigation will be required before it can be assumed that necessary local support will be forthcoming.

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Woodlots may be less efficient than plantations in producing firewood (given allegedly less professional management) requiring as much as one hectare under Sahelian conditions for each person served.

4. Relationship to Other Development Activities. In many cases, multi-purpose rural development projects could include firewood components. At a minimum, this could involve experimental village woodlots or surveys of local patterns of fuel use. In addition, firewood activities can be comingled with agricultural schemes (through inter-cropping) or range management programs.

E. Strategies: Wood Use

Workshop participants placed great emphasis on the importance of finding improved techniques for using wood. Even relatively simple stoves, for example, could double the efficiency with which wood is now used for cooking. Similarly, improved kilns could double the amount of charcoal produced from wood by current methods. Finally, pyrolytic techniques are being tested for producing charcoal and cooking oil from sawdust and other wood products. Widespread adoption of any of these devices could materially reduce the number of trees cut each year.

Considerably more data are needed, however, on the technical, economic and social feasibility of these systems. To have meaning, such data must be acquired through research and testing among potential users in Africa itself. Support for improvements in wood use might therefore be channelled through African institutions engaged in local experiments with small-scale technologies.

F. Institutional Development

Forestry services in Africa are of widely varying quality. Almost all, however, have a long history of devoting their energies primarily to supervision of commercial timber cutting in protected forests. Other skills are required to support activities such as village woodlots, however; and specialized training may be necessary to develop these capacities.

II. AGENDA FOR ACTION

In general, workshop participants felt strongly that the Africa Bureau should immediately establish a clear policy in support of firewood programs. Announcement of such a policy would provide an essential signal to AID personnel in Washington and the Field that serious attention should be given to firewood activities. In addition, specific initiatives were proposed in the areas of research, other project activities, and Africa Bureau staffing.

The firewood problem in Sahel West Africa has reached crisis proportions. Under the aegis of the CILSS, the Sahel countries have designated forestry

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activities (to meet fuelwood needs) a priority, and have designed an initial five-year Forestry Program which begins to address these needs. In response to these concerns, a number of Field Missions in the Sahel have submitted proposals for forestry activities to AID/W. Projects are proposed, in the process of being designed, or actually underway in Mauritania, Senegal, the Gambia, Upper Volta, Niger and Chad.

A. Research

Participants strongly endorsed the idea of a project-oriented firewood study to be conducted in several African countries. This study, the central parts of which would be carried out by African institutions, would address such topics as: major areas of deforestation and growing potential; current patterns of fuel use among rural and urban poor; local perceptions of the firewood problem; available institutions for managing woodlots and other activities. Specific recommendations of workshop participants have been incorporated into the revised scope of work included below as Attachment C.

B. Other Activities

Workshop participants felt that a number of initiatives could be pursued concurrently with the firewood study. Among ideas to which serious consideration might now be given in Washington and the Field are:

- testing of wood stoves, preferably by African institutions involved in development of intermediate technologies;
- pilot experiments with village woodlots, perhaps as part of rural development projects now being prepared;
- firewood plantations near major urban centers, in areas where a clear need for such fuel supplies already exists;
- experiments with various means of determining local desires and priorities, possibly including Peace Corps questionnaires or videotape and film techniques for eliciting perceptions of Africans themselves.

C. African Bureau Staffing

Participants noted with concern that nobody in the Africa Bureau now has full-time responsibility for energy questions as a whole, much less firewood in particular. There was a clear consensus that effective programming could not be pursued in this area without the addition of qualified Washington staff to support new activities.

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ATTACHMENT C

SCOPE OF WORK FOR AFRICA BUREAU FIREWOOD STUDY (REVISED)

I. INTRODUCTION

A. Objectives

The project outlined here has two general objectives:

- Solid information should be provided on Africa's firewood crisis. This would indicate the actual dimensions and nature of the crisis, along with appropriate responses, including the initiation of policy measures.
- In countries where field work is to be carried out, the study process will be used for identification of specific firewood projects.

B. Analytical Concerns

In meeting both of the above objectives, a number of analytical concerns will be dominant. For example:

- How serious is the firewood crisis, from the point of view of firewood users and government officials? and how does it relate in a macro economic sense to the problems of oil imports and strained balance of payments situations.
- Is the crisis primarily urban or rural? (or are these two related "crises," each requiring its own remedies?)
- Over the medium term, is there significant promise for alternative fuels (agricultural wastes, petroleum products, renewable energy), or will primary attention have to be given to preserving and planting trees?
- What is the nature of local social organization, as this might be applied to management of local firewood projects?
- Are there promising opportunities for improving efficiency of wood use, through better stoves or charcoal-making techniques?
- Are there any standard recipes (including systems for evaluating local needs and desires, appropriate tree species, management and financial patterns, etc.) for carrying out firewood projects in various regions?

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**ATTACHMENT C (SCOPE OF WORK FOR AFRICA BUREAU FIREWOOD STUDY (REVISED, CONT'D.))**

**C. Characteristics of the Study**

Distinguishing characteristics of the study include the following:

- Although the work would be administered by a single contractor, most activities would take the form of a series of separate country studies. A summary of significant findings for these countries as a group would be provided by the contractor following completion of the studies.
- Although AID would assist with financing, the major responsibility for country studies would rest with local institutions, whether universities, ministries, or other groups. Where appropriate, the government involved might ask Peace Corps Volunteers to assist with village surveys.
- A key objective of this process would be to mobilize support for national firewood programs. Rather than being treated as "data" in the abstract, information collected would be used as an instrument for project identification.

**II. ACTIVITIES**

The project as a whole would consist of four major phases, spread over a period of approximately 13 months. To provide continuity, work is structured in such a way that a single project manager could supervise and work on the study throughout this period. Dates below assume that a contract to do the work would be signed by the end of November 1978.

**A. Preparation**

About five person-months of work would be devoted to three kinds of preliminary activity:

1. Survey Dimensions and Methodology. The contractor would prepare in draft an outline of material to be gathered through country studies. This would be modified in each country following consultations with foresters, rural development officers, and others during Stage B (below). Provision should be made in the contractor's draft for collecting the following kinds of information:

- areas of deforestation and tree growing potential: In each country, maps might be prepared showing the degree of deforestation (moderate, severe, critical) by area. In addition, data on soils, rainfall, and temperatures could be combined to show areas of greatest potential for growing trees. Much of this information would be available from foresters, meteorologists, soil specialists and others within the government.

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ATTACHMENT C (SCOPE OF WORK FOR AFRICA BUREAU FIREWOOD STUDY (REVISED) cont'd.)

- local surveys: Information to be collected directly from villagers and townspeople would include:
  - fuels currently used (wood, charcoal, millet stalks and other agricultural residues, kerosene, etc.);
  - means by which these fuels are acquired (gathered or made for own consumption; purchased);
  - charcoal-making techniques;
  - prices;
  - trends in use of fuels, and reasons for these trends (fuel availability, price);
  - types and efficiency of fires or stoves used;
  - cooking patterns (e.g., length of time various foods are cooked in different areas and time of day cooking occurs);
  - local perceptions of need;
  - patterns of land and tree tenure;
  - existing institutions for cooperative action.

This information would be gathered in a sampling of villages and towns in areas where firewood projects would be most likely. The contractor's draft should propose a basis for selecting locations and methodologies for carrying out the surveys.

2. Coordination. Also during the preparation stage, the contractor would consult with other groups in North America having a research interest in African firewood problems: Peace Corps, National Academy of Sciences, International Development Research Center, etc. The objective here would be to share ideas and avoid duplication of efforts in the field.

3. Recruitment. Finally, the contractor would recruit country coordinators to work on subsequent stages of the project. The coordinators should already be familiar both with firewood problems and with the countries to which they are to be assigned. In some cases, ex-PCVs with forestry experience in appropriate countries might be available to do this work.

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ATTACHMENT C (cont'd.)

B. Studies (March-August)

Two lines of inquiry would be pursued during this phase, the more important being a collection of specific country studies.

1. Country Studies. It is assumed that the activities shown here would take place in each of six African countries, selected on the basis of strong interest on the part of AID missions and host governments:

- briefing: First, the six country coordinators would meet in Washington for a week-long briefing by the contractor and AID.
- field consultations: After travelling to their assigned countries, the coordinators would spend about three weeks in consultation with host government and other officials. The objective during this period would be to establish local networks of people and organizations concerned with firewood issues, as well as to determine responsibilities for carrying out various elements of the country studies.
- scopes of work: On the average, coordinators would then spend another four weeks working on methodologies and detailed scopes of work with specific local institutions selected to undertake the studies. Draft research outlines prepared by the contractor would be modified at this point in line with local realities.
- surveys: The survey process itself would be carried out by local institutions over a period of about four months. Through the contractor, AID would pay up to \$25,000 toward survey costs in each country. On the assumption that some countries would need additional technical assistance during this period, allowance is made for the coordinator to remain on throughout the survey process in each of two countries. Provision is also made for two visits of about two weeks each by the project manager, in order to check on progress and resolve specific problems arising as surveys proceed.

2. Summary of Firewood Experience. Concurrently with the country studies, about five person-months of research would be carried out on past and present firewood experience in Africa. This would involve both a literature search and interviews (in Europe and the United States) with foresters whose background includes work on firewood projects in Africa. Country coordinators would also be interviewed on their return to the United States.

Lessons drawn from experience through this exercise would be presented in the form of guidelines for effective firewood projects. These guidelines would be distributed to country coordinators prior to their return to Africa for the next stage of the project.

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ATTACHMENT C (cont'd.)

C. Country Reviews (Sept. 1979)

Following completion of the studies, coordinators would return to their assigned countries for about four weeks in order to discuss study results, arrange symposia during which results would be intensively reviewed by relevant government agencies, and assist AID missions to translate findings into concrete project proposals. During this period, the project manager would provide necessary backstopping, discuss preliminary findings with concerned organizations, and begin work on a final report.

D. Summary Report (October - December 1979)

Finally, the contractor will prepare a summary of project findings, spending approximately three person-months on this task. The summary will draw on information collected through: research in Europe and the United States; interviews with government officials in Africa; local surveys; and experience with project development in the countries where studies have been carried out.

To the greatest extent possible, the summary report should draw conclusions as to the overall dimensions and nature of Africa's firewood crisis. Guidance should also be provided on ways of dealing with this crisis.

In general, discussion should be organized around the kinds of analytical questions raised in Section I.B., above. (e.g., is the problem an urban or rural one? are there available "recipes" for carrying out firewood projects? are local organizations in place to support local activities?) Data gathered in the field and descriptions of activities in specific countries would be attached.

III. BUDGET

Total budget for this contract would be about \$394,900 to be allocated as follows:

|                                                                                                 |           |
|-------------------------------------------------------------------------------------------------|-----------|
| A. Salaries (project manager @ \$3,000, country coordinators and research associates @ \$2,500) | \$109,000 |
| Part A: 3 person-months @ \$3,000                                                               | \$ 9,000  |
| 2 person-months @ \$2,500                                                                       | 5,000     |
| Part B.1: 1 person-month @ \$3,000                                                              | 3,000     |
| 20 person-months @ \$2,500                                                                      | 50,000    |
| Part B.2 5 person-months @ \$3,000                                                              | 15,000    |
| Part C: 1 person-month @ \$3,000                                                                | 3,000     |
| 6 person-months @ \$2,500                                                                       | 15,000    |
| Part D: 3 person-months @ \$3,000                                                               | 9,000     |

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ATTACHMENT C (cont'd.)

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| <b>B. <u>Transportation and Per Diem</u></b>                               | <b>\$60,500</b>  |
| Part B.1: 8 r.t. U.S. - Africa @ \$1,500                                   | \$12,000         |
| 86 weeks per diem @ \$350                                                  | 30,100           |
| Part B.2: travel in U.S. and Europe                                        | 4,000            |
| Part C : 4 r.t. U.S. - Africa @ \$1,500                                    | 6,000            |
| 24 weeks per diem @ \$350                                                  | 8,400            |
| <br>                                                                       |                  |
| <b>C. <u>Country Studies</u> (sub-contracts with African Institutions)</b> | <b>150,000</b>   |
| six studies @ \$25,000                                                     | 150,000          |
| <br>                                                                       |                  |
| <b>D. <u>Printing and Other Direct Contractor's Costs</u></b>              | <b>10,000</b>    |
| <br>                                                                       |                  |
| <b>E. <u>Contractor's Overhead (60% of salaries)</u></b>                   | <b>65,400</b>    |
|                                                                            | <b>\$394,000</b> |

David French: July 7, 1978

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**CONTINUATION**

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**FIREWOOD IN AFRICA**

**Discussion Paper for the Africa Bureau Firewood Workshop,**

**June 12-14, 1978**

**(revised)**

by

**David French**  
**4417 Q Street, N.W.**  
**Washington, D.C. 20007**

**prepared for: AFR/DR/SDP**  
**U.S. Agency for International**  
**Development**  
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I. BACKGROUND

Since early 1977, AID's Africa Bureau has given special attention to energy questions. Under AID contract, the Overseas Development Council submitted a lengthy report in February 1977 on "Energy for the Villages of Africa." Subsequently, energy teams visited a number of African countries, including Senegal, Mali, Tanzania, Ghana, Botswana, Lesotho, Swaziland, Upper Volta, Niger, Kenya, Ethiopia, Mauritius and Rwanda. In many of these countries, energy experiments are now being proposed as new activities or for inclusion in existing AID projects.

In response to increased costs and uncertain availability of oil, the Africa Bureau program has concentrated on renewable sources of energy. In line with current enthusiasms about the potential for solar hardware, considerable momentum has developed for testing of such devices as solar cookers and water heaters, solar crop dryers, solar coolers, solar cells and solar pumps. In addition, work is proceeding on indirect uses of solar energy through windmills, small-scale hydroelectric generators, biogas units and pyrolytic convertors. At least some of these devices may ultimately have widespread applicability in Africa.

More recently, the Africa Bureau has added firewood to its energy agenda. From the standpoint of need, pressures on resources, and energy potential, this may prove the most important energy concern of all.

-need: For their energy needs, most Africans are almost wholly dependent on firewood, a situation that will likely continue for decades to come. Taking account of energy from all sources, firewood accounts for 96% of energy used in Tanzania, 91% in Nigeria, 90% in Uganda, 89% in Malawi. Even assuming that use of other forms of energy will increase, total consumption of firewood in Africa will rise 22% between 1970 and 1980. (D. Earl, 1975a: 10,62.)\*

-pressure on resources: At the same time, Africa is rapidly becoming deforested. Outside of Ouagadougou, for example, the land has been stripped of trees for 45 miles in all directions. In Accra and Lagos, people in search of fuel tear the scaffolding from construction sites. At present rates of deforestation, Senegal will be bare of trees in 30 years, Ethiopia in 20, Burundi in seven. (D. French, 1978: 9-10) To the extent that energy use and welfare are bound, much of Africa is now busy undeveloping. Only a major effort at reforestation can reverse this trend.

-potential: Fortunately, forests have almost unlimited energy potential if properly managed. Derek Earl (1975b: 26) estimates that careful use of only 10% of their tropical forests could provide African countries with enough fuel to sustain 5% annual growth in total energy consumption for more than 20 years. In Ghana, John Powell (1978: 119) calculates that the potential power output of wood wastes alone is greater than current national power consumption. Drier

\* - References are to entries in the Annotated Bibliography, Part IV.

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areas of Africa are less favored; but even there, wood represents the only energy source that is both familiar and infinitely renewable.

Given data like these, it is hardly surprising that the Africa Bureau should now seek an expanded firewood program. Somewhat more surprising is the fact that such a program would represent a path-breaking effort among people and organizations concerned with forest resources. Historically, foresters have had very different concerns.

#### A. Firewood in Historical Context

In the fourth century B.C., Plato complained of the effects of deforestation in Attica. Although great forests had once existed in the region, loss of trees had left the mountains "like the bones of a body wasted with disease: the fertile soil has fallen away, leaving only the skeleton of the land." The same problem has confronted different areas of the world at different times throughout history. In this century, it is Africa's turn. By 1948, according to Erik Eckholm (1976: 30) two-thirds of Africa's original tropical forests had been lost; and the rate of deforestation has accelerated since.

Until very recently, Africa's forests have been viewed primarily as a source of timber. In a survey of 135 publications covering forestry issues in 43 countries, Edward Cliff (1973) found the dominant concern to be commercial use of trees, especially secondary species for which only limited markets have existed. Only nine reports dealt with such issues as "extension and public education, including assistance to farm forestry and small owners." Firewood was not mentioned.\*

These priorities have not everywhere been dramatically altered. At an international conference on "Improved Utilization of Tropical Forests," held in Madison, Wisconsin, during May 1978, firewood was nowhere on the agenda. At the Eighth World Forestry Congress, to be held in Djakarta during October 1978, only one of 30 technical sessions is to deal with "wood energy and rural communities." (In contrast, nine sessions are devoted to "forestry for industrial development.") This is at least a step beyond the Seventh World Forestry Congress of 1972, which included no allusion to firewood at all in its closing "Declaration"; but there remains considerable room for further progress.

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\* - For a representative sampling of documents from the period 1964-1974, with emphasis on studies carried out for AID, see: J. Arnold, 1967; Battelle Memorial Institute, 1969; M. Chudnoff, 1973; Development and Resources Corp., 1965, 1967; FAO, 1967; G. Fox, 1972, 1973; A. Freas, et al., 1973; C. James, 1964; R. Koeppen and S. Hutchison, 1973; A. McComb and J. Jackson, 1969; S. Pearson, 1974; R. Wellwood, 1966. Firewood is seldom mentioned and never taken seriously in these reports. McComb and Jackson, for example, assume that firewood in Nigeria will continue to come from existing savanna woodlands, with new tree plantations reserved exclusively for industrial exploitation.

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Progress may be inevitable, since the foresters' long preoccupation with timber is being undermined by two powerful forces. First, the global concern over oil has led to reevaluation of the future role of firewood, which until recently was viewed as a "primitive" energy source whose use was to be discouraged. (D. Earl, 1975b: 24.) At the same time, foresters have been caught up in the development community's reorientation toward specific needs of the world's poor -- who have few greater needs than firewood.

Evidence of this change of direction has accumulated over the past three years. In a dramatic address in April 1975, for example, Jack Westoby called for foresters to turn their attention from the world timber trade to village woodlots and other projects for the well-being of the poor. In the same year, Erik Eckholm published the first of a series of articles showing that the real "energy crisis" for the poor rests in the depletion of firewood supplies. (1975, 1976, 1978.) By April 1977, the countries of the Sahel had formally declared the provision of firewood to be their dominant forestry need. Even though firewood activities will continue to be a minor part of total lending for forestry and paper industries, the World Bank (1978) has at least made explicit provision for such projects in a new forestry sector policy paper.

The convergence of these forces has made it necessary for development agencies to review their ability to carry out firewood projects overseas. The workshop on this subject sponsored by AID's Africa Bureau on 12-14 June 1978 is among the first serious attempts at a specific review of the issue.

**B. Scope of the Workshop**

In practice, firewood is intimately bound to a wide range of development issues. Governments try to settle nomadic herders, whose foraging animals then deplete local supplies of wood. As populations grow, pressures to harvest wood for energy can lead to soil erosion or destabilization of sand dunes. Increased use of dung instead of scarce wood for burning can divert important nutrients from agricultural land. Incursions by wood-starved peasants into protected forests can damage prospects for commercial timber stands. As forested areas retreat from points of energy need, effects ripple through the economy with great cumulative impact: wood is sold commercially rather than gathered by final users; energy costs in towns rise disproportionately for lower-income families. As an issue, "firewood" is thus equally a matter of land use planning, of population policy, of income distribution -- in fact, of "development" in all its complexity.

It is not the task of this workshop, however, to make sense of all these inter-relationships. In fact, we are not even concerned here with the full range of issues falling within the general category of "reforestation." Instead, the workshop's scope is basically limited to production and use of firewood alone.

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There are various reasons for this approach, in terms of time, wood use, and clarity.

- time: In itself, Africa's firewood problem raises more than enough issues to occupy a 2-3 day workshop. It would be inadvisable in the time available to open the proceedings even to a more general discussion of reforestation, with its additional concerns for timber, use of secondary species, trees for food, forest industries, tourism, and so on.
- wood use: In any case, once the relative nonessentials are stripped away, forestry in Africa is firewood, at least as measured by actual wood use. According to the World Bank (1978: 14), 90% of wood consumed annually in developing countries is used for fuel. In countries such as Tanzania, this figure may reach 96%. (FAO, 1971) And patterns of use are unlikely to change greatly in the foreseeable future. In Nigeria's savannah region, for example, about 90% of all wood consumed in 1970 consisted of firewood, a figure which will only drop to 85% by the year 2000. (FAO, 1970)
- clarity: Thanks in significant degree to Erik Eckholm's writings on the subject, firewood has now become an issue with considerable public recognition. In mobilizing support for a new program to grow trees in Africa, it makes obvious sense to wrap the debate around a core issue whose outlines are as clear and vivid as "firewood -- the other energy crisis." Related issues can be introduced later.

For all these reasons, firewood will be the focus of the Africa Bureau workshop. A primary concern will be protection of existing stands of fuelwood and the planting of new ones. In addition, attention will be given to more efficient patterns of wood burning. Thus, ways to improve wood stoves and means of making charcoal will be reviewed.

The ultimate objective of this process is to give the Africa Bureau advice on how to proceed with effective firewood projects. The key issues around which the discussion is likely to be organized are listed in the following section.

## II. ISSUES

A number of firewood issues are outlined here. The accompanying comments are not meant to be conclusive. Instead, the intention is simply to highlight important topics for consideration during the firewood workshop itself. In each case, it would be useful for participants at the workshop to:

- summarize information known to exist on the subject;
- spotlight those gaps in existing information that are serious enough to interfere with program planning;
- draw whatever conclusions seem warranted as guides to creating effective firewood projects in Africa.

In addition, participants may wish to add issues not included here.

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### A. Vanishing Firewood

For purposes of dramatization, there is value in statements like the one above that "At present rates of deforestation, Senegal will be bare of trees in 30 years..." As a guide to action, however, such assertions are less useful. To understand the deforestation process well enough to combat it requires at least three kinds of additional information.

1. Patterns of Loss. Within each country, it is necessary to know accurately which fuelwood areas are under the greatest pressure. Given this information, a sort of silvicultural "triage" would be possible. Some especially devastated areas might be declared "lost," at least for the time being. Relatively robust forests might be set aside for attention later on. A third category would then remain, covering areas where immediate effort could make the difference between rapid deforestation and indefinitely sustained yields of firewood.

The medical metaphor is imprecise, since it may prove necessary on political, humanitarian or other grounds to resurrect even some "dead" lands for firewood uses. Whatever their decisions, however, policy-makers will require information on the extent and geographic patterns of firewood loss within their countries. For the most part, these data now exist to only a limited degree. One issue for the workshop to consider will be the priority to be assigned to assembling such information in usable form.

2. Reasons for Loss. The depletion of firewood reserves has a number of causes. For example:

- agriculture: Trees fall as the need for new agricultural land increases. With growing populations, the end result is the same whether farmers continue to rely on shifting cultivation or are encouraged to settle in one place.
- social: For various reasons, African governments have sought to settle their nomads and restrict migration. The result has often been to destroy ecological balances worked out over centuries between people and land. The environment as a whole has suffered, and firewood with it.
- weather: Compounding the above have been Africa's droughts of the past decade. In many cases, these have finally overwhelmed the thin margins of environmental resilience that had allowed people and their woodlands to survive.

The relative importance of these (and other) causes of firewood loss will vary from area to area, even within a given country. Appropriate ways of dealing with the problem will vary in response. Again, we have only the most general sort of information as to the specific realities of particular places. Provision of such information in areas where firewood projects are being considered may be important.

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3. Local Perceptions. We have been speaking as if to measure "firewood loss" simply required counting absent trees over time. At least as important, however, are local perceptions of what is taking place. How serious does the situation seem to those experiencing it? Is the problem felt primarily as one of availability of fuel, or its price, or the distance people walk to collect it? Firewood projects will gain local support only if they respond to a local sense of need. Few countries have any real mechanism for determining local perceptions, however. The issue here is therefore twofold: are surveys of local attitudes important?; and if so, who should undertake them?

B. Patterns of Acquisition and Use

In thinking about how energy for cooking actually gets from tree to food, four major issues arise.

1. Source. A basic piece of information is how people now acquire their wood or charcoal. Do they gather (or make) their own supplies or do they rely on traders? Who does most of the work: women? children? men? This kind of information is especially important in thinking through the social and economic effects of new projects.

2. Amounts Used. Fuel use varies greatly from one area to another. In a village in Tanzania's Usambara Mountain, for example, Patrick and Anne Fleuret (1978) estimated that the average person uses about 4.5%kg of wood each day, in addition to unspecified amounts of charcoal for warmth at night during the cool season. In Bara, Sudan, Turi Digernes (1977: 77, 91) estimated daily per capita consumption at 2.0 kg of wood and 1.1 kg of charcoal. In a rural area of Upper Volta, Elizabeth Ernst (1977: 11) found people using just 0.8 kg of wood daily per person, and this only during the six months of each year when millet stalks were unavailable for cooking. Edmond Uhart (1975: 2) estimates that half of the Sahel's urban population uses charcoal, at a per capita rate of 0.5 kg each day.

These are important numbers to know before carrying out specific firewood projects, since a major purpose of these activities will be at least to keep pace with local consumption. In addition, it would be useful for countries to have a wide enough sampling of consumption patterns to be able to make accurate estimates of firewood use on a provincial and national level. The real scope of the "firewood crisis" in Africa might then become apparent, along with the volume of resources required to improve the situation.

So far, however, only a scattered handful of firewood and charcoal surveys has been carried out, using varying methodologies. Clearly, there is need for more careful work in this area. Assisted by the Overseas Development Council, the Peace Corps is now designing an energy questionnaire for use by its Volunteers. If addressed to operational needs of host governments, this questionnaire could provide invaluable information in support of firewood projects in Africa.

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3. Technologies of Wood Use. It is widely assumed (see Section II.E, below) that the efficiency of wood use in many African homes could be greatly increased by use of improved stoves or better utensils. In order to know how much attention such technologies actually deserve, however, we need to know more about present ways of using wood. In various regions within a given country, for example, is cooking done with open fires or simple stoves? What is the actual efficiency of present techniques? If charcoal is used, how is it made. Are utensils adapted to stoves in ways that minimize loss of heat? Again, a questionnaire such as that being prepared for Peace Corps use might quickly provide at least partial responses to these questions.

4. Impact of New Projects. The above points out information to be gathered on patterns by which wood and charcoal are currently acquired and used. At least as essential is to consider the likely impact of new firewood projects on these patterns. Improved stoves, for example, may require new utensils or altered ways of cooking. Village woodlots could eliminate work either for women who now walk long distances to gather wood or for traders who live by transporting fuel from even more remote areas. A program for converting sawdust to charcoal could lower fuel prices and provide additional employment in urban areas while throwing rural charcoal-makers out of work. To the extent possible, all such effects should be considered in choosing among firewood projects. The scope of fuel use surveys should therefore be broad enough to allow reasonable guesses to be made as to what these effects will be.

C. Strategies: Conservation of Existing Trees

Even in the Sahel, almost all African countries have at least some remaining woodlands or areas of usable brush. To protect these areas would curtail soil erosion while giving trees an opportunity to regenerate and to become able once more to sustain large firewood yields over time. According to Fred Weber (1977b: 23), such preservation of existing vegetative cover is especially important in northern zones of the Sahel, although it should be considered for other areas as well.

A disadvantage of this approach is that areas not already stripped of trees may be those most distant from points of demand for fuel. To concentrate on these areas alone would therefore do little to make firewood more available to people most in need of it. In addition, protecting woodlands may mean turning away people with clear rights to use these trees under traditional law. Even if desirable, this may not be simple to do.

On the other hand, a strategy of conserving existing trees also has distinct advantages, notably in being relatively economical. In addition, this approach avoids the need to displace people from land being used for food production or other purposes. Finally, conservation by definition concentrates on land with a proven capacity for growing trees.

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Planting Trees

Another means of getting trees to grow is to plant them, whether through direct seeding, cuttings, or transplanting from nurseries. (See manuals on the subject by M. Laurie, 1974, and F. Weber, 1977a.) This is not necessarily easy. According to Clyde Sanger (1977:51), a number of projects have already shown "the unacceptably high cost of mechanized planting, and in Sahelian regions, where the rainfall is both meager and unpredictable, hand-planting of large areas is not practical in the few days when there is good chance for survival." Where feasible, however, planting projects allow trees to be placed near cities and villages most in need of them.

1. Areas for Planting. Specific places where trees are to be planted will depend on need, growth potential, and alternative uses for land.

-need: Information acquired according to Section II.A.1, above, will indicate where deforestation is taking place most rapidly. Information in response to Section II.B.2 will show amounts of firewood and charcoal being used in various areas. The combination of these data will suggest places where need to plant trees is greatest.

-potential: The ability of the land to support large numbers of trees will depend on soil characteristics, rainfall (annual amounts and distribution through the year), and temperatures. These data may not always be readily available, and an early part of any firewood program might well be to assemble them.

-alternative uses: Land most suitable for planting trees is likely already to be in use for grazing or growing food. To avoid confrontation, consultations will be required between governments and residents to determine which areas can most easily be diverted to firewood production.

2. Trees Species. A number of experts have advanced the merits of particular trees for reforestation: eucalyptus (E. Uhart, 1975, 1976a); leucaena (M. Bengé, 1976; NAS, 1977a); pinus eldaricus. In practice, however, selection will depend on a combination of climate, the suitability of a given tree for firewood and charcoal, and local preferences. Discussion of these points is likely to be advanced by a forthcoming National Academy of Sciences publication, in which roughly 70 bush and tree species suitable for firewood are reviewed for use in various climate zones around the world.

3. Project Scale. For illustrative purposes, tree-planting activities can be divided into large scale plantations and local woodlots.

-large-scale plantations: Depending on their location, firewood plantations can vary greatly in cost. Edmond Uhart estimates the expense of such plantations per hectare to be \$100 on already-irrigated land in

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the Sudan (1976a:16), as opposed to \$690 near urban centers in the Sahel (1975:7). Fred Weber (1977b:9) assumes costs of \$565-725 per hectare for planting and maintenance through a plantations's first year. According to Weber, the total cost of firewood from such projects is about \$10 per ton.

-local woodlots: Another technique is to decentralize firewood production, creating relatively small woodlots under local supervision. Both China and South Korea, which have had extraordinary success with reforestation programs, have relied heavily on this approach. (E. Eckholm, 1978:25.) Since people may grow and cut their own trees within these projects, it may be extremely difficult to estimate labor and firewood costs or to calculate the economic returns to such activities.

Of these two approaches, large-scale firewood plantations require considerably greater commitments by governments in terms of budgetary outlays and personnel for direct project administration over time. A program to establish village woodlots, on the other hand, will make large initial demands on extension services responsible for working with local groups to get projects underway. To make adequate progress by either route, governments will have to devote far more attention to firewood needs than has yet been the case.

4. Relationship to Other Development Activities. A final issue in planting trees is the relationship of such activities to other development projects, especially in rural areas. For example (F. Weber, 1977a: 11-12):

-agriculture: In places where production of both firewood and agricultural goods is being encouraged, these needs can sometimes be met on the same land by intercropping, or "taungya" methods. In this system, such crops as peanuts are grown between the new rows of trees.

-grazing: In collaboration with range management schemes, firewood projects can include vegetation suitable for grazing. Grazing in such circumstances must still be carefully controlled, but it need not be prohibited altogether.

These particular approaches have already been tried, for example, as part of a forest reserve program in Nigeria (S. Adeyoju, 1975) and tree-planting projects elsewhere. Firewood projects can also be tied to soil stabilization, fisheries, commercial gum production, windbreaks, or other rural development activities. In response to both local needs and a desire for administrative economy, inclusion of firewood components in multipurpose projects seems an increasingly popular way to approach the problem. (Club du Sahel, 1977:2-3; World Bank, 1978.)

E. Strategies: Wood Use

One reason for excessive consumption of trees in developing countries is the inefficiency with which fuelwood is used. To double ~~efficiencies~~ efficiencies

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now prevailing would cut by nearly half the total number of trees used each year, and this degree of improvement is at least technically within easy reach. Social and economic factors suggest caution in what we can actually expect to achieve, but it is nonetheless worth giving serious attention to possibilities for improved wood stoves and better ways of making charcoal.

1. Wood Stoves. A well-designed wood stove makes productive use of 40-65% of available energy, as opposed to 6-10% in the case of open fires. (S. Draper, 1977: 4-5.) Even relatively simple stoves for use in developing areas could double the efficiency of firewood use. In acknowledgement of these possibilities, people for some time have proposed wood stove research as an important part of overall energy strategies. (See, e.g., A. Makhijani, 1976; R. Revelle, 1975.) To date, however, only a relatively modest assortment of improved stoves has even been designed and tested, with negligible result. (See, e.g., Canadian Hunger Foundation, 1976; K. Darrow and R. Pam, 1976; J.D. Walton, et al., 1978.)

In part, the absence of progress follows from the fact that wood stoves have absolutely no cachet as a development technology, especially in contrast to more glamorous (if less useful) devices such as solar cookers. In addition, new stoves have often been designed to Western rather than local tastes. It seems a given among designers, for example, that stoves should be smokeless, although wood smoke often plays an essential role in African homes in discouraging bugs that would otherwise devour both people and dwellings. Further, new designs have seldom allowed for local variances in cooking utensils and techniques. Under the circumstances, it is unsurprising that no accounts appear to exist of improved wood stoves that have actually been used and found acceptable over time in African homes.

Fortunately, work continues. Both the World Bank (in Tanzania) and AID (in Botswana) are investigating possibilities for local stove trials. National institutions concerned with intermediate technologies are likely to give increasing attention to the problem. Support for such efforts seems an integral part of any attempt to deal with Africa's firewood crisis.

2. Charcoal. Use of charcoal for cooking can be expensive. According to Edmond Uhart (1975:3), an urban family of five in Upper Volta now spends more than \$155 each year on charcoal. And nearly everywhere, reliance on this source of fuel is on the increase. In Tanzania, for example, the FAO (1971) estimates that charcoal's share of the combined consumption of firewood and charcoal will rise from 3% in 1970 to 25% in 2000.

A principal cause of growing reliance on charcoal is the increasing distance fuel must travel from tree to user. Although charcoal costs more than firewood to prepare, it is considerably less expensive to transport. As woodlands retreat from settled areas, a point will be reached where it becomes cheaper to convert firewood to charcoal before carrying it to towns. (T. Digernes, 1977: 26.) Using data from East Africa, Derek Earl (1975a:74) has calculated that the "point of indifference" between wood and charcoal

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supply will be reached when trees are about 50 miles from the final users of their energy.

All else equal, charcoal is also likely to be preferred for the concentrated and steady heat it delivers. In addition, charcoal's relative smokelessness may be an asset in those places where smoke is not valued as an insecticide. As a result of both cost factors and burning qualities, more and more of Africa's meals in the future will be cooked over charcoal.

This raises issues in terms of wood use, improved kilns, and large-scale pyrolysis.

-wood use: It is unclear what effect the increased use of charcoal instead of firewood will have on consumption of trees. Depending on whether traditional methods or modern kilns are used (as well as on whose figures you accept), yields of charcoal by weight are 8-25% of the wood from which it is made. (D. Earl, 1975b: 25; E. Uhart, 1975:6.) Allowing for the fact that energy yields of charcoal are about twice those of equivalent weights of wood, 50-84% of the energy in wood is therefore lost by converting it to charcoal. On the other hand, Sydney Draper (1977: App.2) cites data indicating that charcoal's energy is actually used about 3.7 times as efficiently in the home as is energy from firewood. Whether charcoal or firewood finally requires more trees to get a given amount of energy into the evening meal may therefore vary according to a number of local energy practices. Certainly, a great deal more information will be required before any generalizations can be made on the subject.

-improved kilns: Improved techniques could at least double the efficiency with which wood is converted to charcoal. For this purpose, various attempts have been made to design or adapt charcoal kilns for use in Africa. (e.g., see E. Little, 1972; E. Uhart, 1976a.) Such kilns can cost \$1000 or more, however, an enormous sum for people now making charcoal by burning wood under mounds of earth. In Ghana, where a Tranchant kiln was field tested by the Department of Forestry, the system's cost and complexity meant that no charcoal-makers could be found to use it. (J. Powell, 1978: 124.) Clearly, additional work would be valuable in searching for kilns appropriate to African conditions.

-large-scale pyrolysis: Through relatively large-scale pyrolysis techniques, wood products and agricultural wastes can be converted to charcoal, cooking oil, and gas. According to John Tatom (1977:2), such techniques can increase by a factor of 2.5 the amount of useful energy from a given amount of biomass, assuming that suitable stoves are available to use the pyrolytic oil. In Kumasi, Ghana, a pyrolytic converter is now being tested that would make oil and charcoal from sawdust. (T. Chiang et al., 1976.) Until considerably more data are available on the technical, economic, and social feasibility of these systems, however, it will be difficult to make any predictions about their usefulness.

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3. Relation to Other Energy Projects. In thinking about technologies of wood use for cooking, it is tempting to speculate about prospects for alternative devices, notably solar cookers and biogas systems. Such speculations are not within the scope of this workshop, however. In general, firewood planners should be warned against the lure of any gadgetry that would divert their attention from wood stoves and charcoal production.

There are various reasons for excluding alternative systems from the debate over Africa's firewood problem. In the case of solar cookers, the reason is simply that these devices are a waste of money. As a recent study by the Georgia Institute of Technology observed: "Although programs to develop solar cookers have been actively pursued for over 100 years, they have never found acceptance at the village level." (J. Walton, et al., 1978: iii.) For Africa, this is easy enough to explain. To begin with, most cooking is done when the sun is down. (P. and A. Fleuret, 1978; E. Ernst, 1977.) Further, many people prefer to cook indoors. In addition, solar units can cook only one thing at a time, generally in ways inconsistent with local utensils, foods, and cooking methods. Solar cookers will continue to fulfill their role in broiling not more than three hot dogs simultaneously at American energy fairs, but there is no reason to believe that they will ever make any measurable impact on the consumption of fuelwood in Africa.

Biogas systems raise different questions. These systems already have an impressive track record in China and India and clearly show at least some promise for African applications. However, major biogas programs in Africa are likely to encounter serious obstacles. Dung will have to be collected from animals whose movements customarily are not restricted. New kinds of organizations will have to be created to manage village-scale systems. For family systems, extension services will have to be mobilized to provide widespread instruction in a new technology of some complexity. Methane stoves will have to be introduced, probably along with new sorts of utensils. From digester to utensil, extensive testing under local conditions will be required for each of the system's components, which are likely to vary from area to area depending on available materials, income, and skills.

None of these barriers is insurmountable, but they suggest that we be modest in our expectations of biogas. Improved wood stoves have had difficulty in gaining acceptance in Africa, although these often require little more than placing a new surface between fire and pan. We can only begin to imagine the problems of introducing a system for cooking that requires new investments, knowledge, and ways of living at every point from the production of fuel to its final use.

Clearly, the future for biogas in Africa is extremely uncertain. At best, any large-scale deployment of these systems is decades away. People concerned with Africa's firewood problem should hold their attention urgently to stoves and charcoal, and leave the biogas to others.

F. Institutional Development

As far as AID is concerned, firewood programs will necessarily be implemented through African governments. This raises a number of issues, notably the wide variety of government agencies that may have to become involved, characteristics

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of the forestry services that will play a leading role in such programs, and needs for institutional change.

1. Government Agencies. Writing generally about forestry and anti-desertification programs in the Sahel, Fred Weber (1977b: 33) notes the need somehow to coordinate efforts of governmental services concerned separately with livestock, forestry and agriculture. In the specific case of firewood, ministries dealing with energy policy or technological research may also become involved. At a minimum collaboration will be required among three different kinds of groups:

- forestry services: Whatever their other limitations (see Section F.2, below) forestry services will know more than anybody else about existing trees and the technical aspects of planting new ones. In developing firewood programs, these obviously are necessary skills, if not sufficient ones.
- rural development agencies: At a minimum, various rural development services will have to be consulted in order to reconcile firewood activities with agricultural and livestock objectives in particular areas.

In addition, these services may have the extension capabilities necessary, for example, in working with local groups to finance, prepare, and maintain village woodlots.

- energy agencies: University departments and government offices concerned with energy might logically do jobs ranging from village energy surveys to research into stoves and charcoal technologies.

Of these groups, forestry services will presumably take the lead role in coordinating firewood programs.

2. Characteristics of Forestry Services. According to S. Kolade Adeyoju (1976:40), the training most foresters receive has little relevance to new issues arising when forests are viewed as more than simply a source of timber. In fact, the historical preoccupations of forestry services may actively conflict with effective firewood programming:

- markets: African forestry services have been oriented to the preferences of wood consumers abroad rather than at home. Available techniques of market research are therefore of little use in determining needs of local firewood users.
- species: Choice of tree species has been based on the workability, color, and strength of wood for foreign sale, rather than on growth characteristics and energy values for village use.
- location: Trees have generally been planted near industrial processing centers and means of transportation to ports. Location theories for planting firewood, on the other hand, would stress scattering of woodlands near points of final use.

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- clientele: Foresters have gained sophistication in ways of encouraging private (and often foreign) interests to exploit their trees. Much less effort has gone into developing an ability to work closely with local groups at home.

In sum, as is true of many development professionals, foresters have achieved great competence in doing jobs which are no longer considered sufficient to meet direct needs of the world's poor. If firewood is the area of need in which foresters have the most to offer, their agencies face major changes before they will be able to take effective action.

3. Institutional Change. In many areas of Africa, creation of systems at the local level for planting or preserving trees amounts to introduction of a new "technology" of resource use. Historically, however, attempts at transfer of technologies in rural areas have tended to fail. This has been particularly true where technology "softwares," such as new ways of relating to trees, have been at issue. (D. French, 1977.)

To improve chances for success requires that changes be made through an intensive process of collaboration over time between villagers and outside "technology catalysts," in this case foresters or rural extension workers. (Canadian Hunger Foundation, 1976; K. Darrow and R. Pam, 1976.) In terms of training, staffing patterns, and resources, forestry services by and large do not now have the ability to work in this way on a large scale. Whether alone or in cooperation with other arms of government, foresters will have to develop these skills before major firewood programs can be expected to succeed.

#### AGENDA FOR ACTION

The workshop should be prepared to make strong recommendations for Africa Bureau action to establish a significant firewood program. Although participants may wish to suggest additional areas in which activity would be appropriate, a minimum agenda for action should include research, a variety of project activities, coordination with other groups, and Africa Bureau staffing.

#### A. Research Priorities

It is clear that firewood initiatives in Africa cannot wait until all possible ramifications have been explored through an elaborate research program. Nonetheless, whether done concurrently with other projects or used as a basis for their design, certain studies are essential.

1. Summary of Relevant Experience: It has become a cliché that foreign assistance agencies are constantly reinventing the wheel. In the case of firewood, this would take the form of improvising projects while ignoring relevant experience from the past and present. During both the colonial and post-colonial eras in Africa, a great number of forest management projects have been set in motion. Sometimes, these have even taken account of local wood requirements for

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purposes such as firewood. Without spending a great deal of time on the matter, someone could usefully review literature and interview foresters to determine why such projects succeeded or failed. The objective would be to provide guidelines from experience for improving future activities.

2. Information Gaps. The discussion of firewood issues in Section II, above, has alluded to a number of areas where existing information may be inadequate for sound project planning. Workshop participants should consider which of these areas most urgently demand attention. Among the most obvious needs seem to be these:

- areas of deforestation: In Section II.A.1, above, mention was made of the need to assemble information, country by country, on places where deforestation is most rapid. In some countries, aerial photographs will be available for forest areas: aerial surveys were carried out during 1957 and 1975 in Niger, for example, and during 1956 and 1966 in The Ivory Coast. Existing satellite imagery may also be useful. For the most part, however, adequate data can be collected simply by talking with foresters in the countries concerned. Maps could then be prepared showing critical areas of deforestation in each country.
- firewood and charcoal consumption: As mentioned in Section II.B.2, it is necessary also to develop data on actual consumption of firewood and charcoal. At least in crude terms, foresters or rural development officers might be able to provide this information; and preliminary maps could rapidly be drawn to represent current patterns of fuel use. Over the longer term, however, it may be necessary to support a widespread program of local surveys in order to develop fuel consumption figures of greater accuracy.
- growing areas: Section II.D.1 speaks of determining areas of greatest potential for growing trees, in terms of soil, rainfall, and temperatures. In many countries, basic data required to identify these areas may already exist. Perhaps in the form of map overlays, presentation of these data together with information on deforestation and fuel use could quickly suggest priority areas for firewood projects. (On the need to develop such information, see e.g. FAO, 1971; K. Openshaw, 1976: 8.).
- charcoal and stove techniques: As outlined in Sections II.B.3 and II.E.1-2, there is need for a great deal of data on current technologies of firewood use. This is especially true in terms of prevalence and efficiencies of wood fires, wood and charcoal stoves, and traditional processes for making charcoal. Presumably, village-level surveys will be needed to acquire such data.
- social environment: Ultimately, firewood programs will succeed only to the extent that they are consistent with social realities in the specific areas where they are to be carried out. Section II is replete with

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references to such issues: local perceptions of the extent and nature of the firewood problem (A.3); local organization of functions such as gathering, processing, and transport of wood or charcoal (B.1); alternative claims on land (D.1,4); availability of local groups to supervise village woodlots (D.3); social conditions influencing acceptability of new stoves or ways of making charcoal (E.1,2). Consideration of such variables should be at the core of any village survey process.

3. Methods and Implementing Groups. To oversimplify, firewood research for Africa implies talking with either of two groups of people: foresters or villagers. The nature of the dialogue is different in each case, and these jobs might well be handled separately.

- foresters: The Africa Bureau could contract with an outside group to talk with foresters in Africa and abroad, as well as to review available case studies and other project-related material. In terms of the research priorities outlined above, the contractor would concentrate on summarizing relevant experience, as well as delimiting areas of deforestation and potential growing areas. Much of this work could be done by ex-PCVs with forestry experience in specific countries, under overall supervision of the contract manager.
- villagers: At the same time, village surveys would be undertaken by Peace Corps Volunteers or national research organizations. Emphasis here would be on patterns of firewood and charcoal consumption, existing charcoal and stove technologies, and local social environments.

This work would be carried out in countries where host governments, AID Missions, and Peace Corps offices expressed a strong interest in firewood. In each country, the information thus acquired could serve as the basis for a significant firewood program.

B. Other Activities

Concurrently with the research program sketched above, work could proceed in at least three other areas: program guidelines, initial projects, and uses of information.

1. Program Guidelines. A valuable activity now would be preparation of more detailed guidelines to assist Africa Bureau personnel in thinking about firewood issues. Background information would be included along the lines of material in this discussion paper. Current AID reforestation projects might be reviewed briefly in terms of their responsiveness to firewood needs. Finally, specific attention should be given to the methodological problems of evaluating firewood proposals.

These problems can be severe. To take an example, Fred Weber (1977b: 10) has estimated that the total cost of a ton of firewood from new plantations would be \$10 in areas where the current price is only about \$6. The planta-

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tion projects appear of dubious value, until we reflect that \$6 firewood is achieved by indiscriminate destruction of scarce woodlands. The actual cost of present supplies is therefore at least \$6 per ton plus the future expense of replanting the trees. From this perspective, plantations seem much more competitive.

Firewood projects are likely to be more worthwhile than the raw figures suggest in other ways as well. As the FAO has pointed out (1975), forestry activities provide a wide range of environmental benefits, of which turning back the deserts is only the most obvious. Trees also help provide pure air and water, shade, more beautiful surroundings, and protection for wildlife, side-effects whose value is seldom internalized in calculating project returns. In addition, firewood and charcoal cut back on the need for kerosene and other imported fuels. As a partial alternative to petroleum-based development, firewood becomes especially appealing when shadow prices for labor and foreign exchange are taken into account. (D. Earl, 1975a).

In sum, adequate evaluation of firewood projects can be analytically quite complex. A series of program guidelines outlining these complexities and suggesting ways of dealing with them would be useful for Missions and other groups engaged in reviewing such projects.

2. Initial Projects. Especially in the Sahel, some African reforestation projects with firewood components are already underway. Even before the research and methodological activities described above are completed, additional projects might also be started.

Especially important are activities for which lead times are long and needs already apparent. An example might be training of forestry officers in ways to collaborate with local groups in developing village woodlots. Also, research might begin immediately into stoves or charcoal kilns adapted to local resources, practices, and skills. In the latter case, work might start with modest experiments financed through the Africa Bureau's small-grant project for "Improved Rural Technology."

3. Information. In many ways, firewood projects are a new kind of endeavor for AID, for cooperating governments, and for the local groups who will carry them out. A difficult process of communication will have to take place among all these groups, in order that each understands the nature of the problem, the ways in which others view it, and the respective obligations of various parties in project implementation.

As this process is acted out, it will be evident that some ways of communicating information are more accurate, more complete, more compelling, or more economical than others. To convince people of the gravity of the situation, for example, slides are better than words and films better than either. To reach large numbers of people in rural areas, radio broadcasts and portable audiovisual displays may be necessary. To capture the complex social realities with which projects will have to be in harmony at the local

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level, videotape or film would be an invaluable supplement to written questionnaires.

These considerations cut across all the problem areas described in this paper so far. As action is taken in each of these areas, special attention should be given to innovative ways of making information clear and vivid to those who need it.

C. Coordination

As it proceeds with its firewood program, the Africa Bureau will need to remain in close contact with other organizations concerned with Africa's trees. Chief among these, of course, will be government agencies and local groups in Africa itself. In addition, however, there currently is specific need for coordination with the Peace Corps, other donors, and the National Academy of Sciences.

1. Peace Corps. Along with AID, The Peace Corps has been slow to allocate resources to Africa's firewood problem. Of 500 PCVs working in the Sahel, only 31 are assigned to forestry (including wildlife management), and fewer still are working directly on firewood. (F. Weber, 1977c: 8.) Other PCVs in rural areas could presumably make time available for activities such as energy surveys, but proposals to this end so far remain on paper.

As both AID and Peace Corps increase their firewood activities, however, possibilities for cooperation will be considerable. In a joint statement issued April 3, 1978, the Director of the Peace Corps and AID's Administrator stressed the degree to which both organizations "now share a common interest and concern in responding to basic human needs in such areas as rural development..." The statement went on to propose a joining of AID money and Peace Corps skills for projects at the local level. From gathering of data to planting of village woodlots, there will be great scope for such collaboration within national firewood programs, an opportunity which should be actively pursued in both Washington and the field.

2. Other Donors. AID is now working on forestry projects for a number of African countries (including Gambia, Niger, Mauritania, Senegal, and Upper Volta), although the extent to which these activities will address firewood needs is not always clear. The World Bank has included firewood components in forestry projects for such countries as Tanzania, Rwanda, Burundi, Niger, Mali, Upper Volta, and Nigeria. The International Development Research Center is working to grow firewood within village woodlots in Niger and irrigated forest plantations in Mali. (C. Sanger, 1977: 19-20.) In addition, many other bilateral and multilateral programs support forestry activities in developing countries generally (C. Mackie, 1978) and Africa specifically (e.g., Club du Sahel, 1977).

Except for the Club du Sahel, there at present is no mechanism for coordinating the firewood projects of various donors in Africa. The workshop should consider the extent to which such coordination is necessary, along with

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means by which it could best be carried out.

3. National Academy of Sciences. The National Academy of Sciences is under contract to AID's Sahel Development Program to investigate a range of environmental issues in Sahelian countries. Among areas of primary concern is "integrated resources management," including forestry. This may imply research by NAS in the Sahel into questions which another contractor will be investigating elsewhere in Africa. For these efforts to be most useful, survey techniques and scopes of the respective investigations should be coordinated in advance of any field work.

D. Africa Bureau Staffing

A final area in which the workshop might provide guidance is that of Africa Bureau staffing. At present, the Bureau has nobody with full-time responsibility for energy questions as a whole, much less firewood in particular. Only limited help can be expected from the single expert recently recruited by AID's Office of Energy to handle biomass questions worldwide. If the Africa Bureau is to undertake a significant firewood program, it will need staff to deal with this. It would be useful to consider the skills required to do the job right.

IV. ANNOTATED BIBLIOGRAPHY

1. ADEYOJU, S. Kolade. 1975. "Where Forest Reserves Improve Agriculture." in Unasylva, Vol. 27, No. 110.

Creation of forest reserves is often assumed to conflict with interests of local farmers and herders. By allowing for multiple uses of forest land, these difficulties can be minimized. The Nigerian forest service, for example, is experimenting with a taungya (intercropping) system; and land in savanna reserves has been set aside for grazing. Even where farmers are made to settle outside forest areas, their need to use available land more effectively may lead to improved agricultural practices.

2. ADEYOJU, S. Kolade. 1976. "Land Use and Tenure in the Tropics." In Unasylva, Vol. 28, Nos. 112-113.

As forest activities in Africa grow beyond the traditional pre-occupation with timber production, new approaches to ownership and use of land will be required. Problems inevitably will arise in trying to reconcile traditional forms of land tenure with national economic objectives. The technical background of most foresters is of little help in dealing with such issues. Forestry services need better communication with local groups in order both to explain new policies and to understand existing land use patterns.

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3. ADEYOJU, S. Kolade and E. N. Enabor. 1973. A Survey of Drought Affected Areas of Northern Nigeria. Ibadan: University of Ibadan, Department of Forestry. November.

4. ARNOLD, J. 1967. Malawi--Investigating Wood Requirements (Report to the Government). Rome: FAO.

Concentrates on forest industries, although estimates are included of future fuelwood requirements.

5. ARNOLD, J. and J. Jongma. 1977. Wood as a Source of Energy in Developing Countries (preprint). Rome: FAO

6. Auchter, Richard J. 1976. AID Annual Report. PASA TA(AG)03-75. Madison, Wisconsin: U.S. Forest Products Laboratory. January.

7. BATTELLE MEMORIAL INSTITUTE. 1969. Liberian Forest Policy. Washington, D.C.: AID.

Calls for rapid exploitation of forests, with secondary species left to protect the land after more valuable trees are removed.

8. BENE, J.G., H.W. Beall, and A. Cote. 1977. Trees, Food, and People: Land Management in the Tropics. Ottawa: International Development Research Centre.

9. BERGE, Michael. 1976. Bayani, Giant Ipil Ipil (Leucaena Leucocephala): A Source of Fertilizer, Feed and Energy. USAID Agriculture Development Series. Washington, D.C.: US/AID.

Notes that in proper soil and climate, Bayani can grow as much as 20 meters in six years. Bayani can be used for food, alcohol, lumber and fertilizer as well as fuel.

10. BETHEL, J.S. 1977. Wood for Fuel in a Tropical Forest Utilization System. Research Reports Contribution No. 29. Seattle: University of Washington, Institute of Forest Products. October.

11. CANADIAN HUNGER FOUNDATION and Brace Research Institute. 1976. A Handbook on Appropriate Technology. Ottawa: Canadian Hunger Foundation. April.

Includes instructions for making a smokeless wood stove, based on a design from Ghana's Department of Social Welfare and Community Development. Summary sections of the Handbook give considerable attention to methods of transferring such technologies. A key role is that of "appropriate technology catalysts," who are cautioned to gain a thorough knowledge of the communities in which they work

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and to involve community members throughout the process of articulating needs, exploring solutions, and introducing new techniques.

12. CATINOT, R. 1974. "Contribution du forestier a la lutte contre la desertification en zones seches." In Bois et Forets des Tropiques. May-June.
13. CENTRE TECHNIQUE FORESTIER TROPICAL. 1975. Possibilities de production de certaines forets du Tchad en bois de feu, charbon de bois et autres produits. Report for FAO and UNDP.
14. CHIANG, Tze, I., et al. 1976. Pyrolytic Conversion of Agricultural and Forestry Wastes in Ghana: A Feasibility Study. Report for AID/OST. Atlanta: Georgia Institute of Technology. July.

Proposes testing in Ghana of a system able to convert up to six tons of sawdust per day into charcoal and pyrolytic oils. Estimates that such a system would be profitable if operated 2-3 shifts each day.

15. CHUDNOFF, Martin. 1973. Development of the Tropical Wood Resources. Washington, D.C.: AID/OST. November.

Reviews available literature on tropical flora, primary tree species, roundwood removals, and other information relevant to commercial use of forest resources in such countries as Nigeria and Gabon. Of particular concern is the absence of data which might lead to greater exploitation of secondary species.

16. CLIFF, Edward P. 1973. Utilization of Tropical Forests: Review of the Forestry Literature in the A.I.D. Reference Center. Washington, D.C.: AID/TAB. November.

Reviews 135 publications covering forestry issues in 43 countries. The dominant concern is to accelerate commercial use of trees, especially secondary species for which only limited markets now exist. Emphasis is on improved research, policies, and practices on the part of central governments and major private concerns. Only nine reports deal with such issues as "extension and public education, including assistance to farm forestry and small owners." Firewood is not mentioned.

17. CLUB DU SHAEL. 1977. Summary Record of Club du Sahel/CILSS Meeting on Ecology and Reforestation (Paris, 12-13 October 1977). November.

As of October 1977, the proposed CILSS reforestation program included 77 national and 7 regional projects, calling for \$146 million in external assistance for such activities as dune stabilization, village plantation, land use planning, tree

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nurseries, research, and training. In line with the program's overall objectives, a number of these projects made specific provision for fuelwood production. Specific commitments and potential activities of various donors are reviewed.

18. DARROW, Ken and Rick Pam. 1976. Appropriate Technology Sourcebook (second edition). Stanford, California: Volunteers in Asia. November.

Includes a brief chapter on wood, sawdust and rice hull stoves. The book's introduction emphasizes that effective use of such devices is a function less of gadgetry than of the process through which new technologies are found and applied. This process must be community-based and participatory, leaving room for outsiders primarily as catalysts and as sources of limited, short-term technical support.

19. DELWAULLE, J.C. 1973. "Desertification de l'Afrique au Sud du Sahara." In Bois et Forets des Tropiques. May-June.

20. DELWAULLE, J.C. 1976. Le role de la forestiere dans la lutte contre la desertification. CILSS Consultation, Ouagadougou. April.

21. DEVELOPMENT AND RESOURCES CORP. 1965. The Development of Southeast Liberia: A Report to the U.S. Agency for International Development. New York: Development and Resources Corp. December.

With respect to forest resources, recommends "aggressive and thorough exploitation by private operators" in order to increase timber production.

22. DEVELOPMENT AND RESOURCES CORP. 1967. Forest Resources of the South west Region, Ivory Coast. Washington, D.C.: AID.

Recommends technical and market research to expand export and commercial use of trees.

23. DIGERNES. Turi Hammer. 1977. Wood for Fuel--Energy Crisis Implying Desertification: The Case of Bara. the Sudan. Bergen: Universitetet i Bergen, Geografisk Institutt.

In fragile ecological areas, population pressures and poor land management can combine with shortages of rainfall to produce rapid desertification. Patterns of fuel use during this process pass through four stages. (I: People gather their own wood from local fields and forests. II: As the immediate area becomes desertified, wood and charcoal are supplied commercially from surrounding land. III: As the desertified area extends outward, wood and charcoal come from land around smaller villages nearby; kerosene and other imported fuels are used. IV: Desertification

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spreads to nearby villages, leading to increasing dependence on imported fuels.) In Bara, which is now in Stage III of this process, annual per capita expenditures for fuel include ₦6.25 for charcoal, ₦3.24 for wood, and ₦6.60 for kerosene (used for lighting and cooking). Daily per capita consumption amounts to 1.98 kg of wood and 1.11 kg of charcoal. To avoid the worst consequences of Stage IV desertification, attention should be given to more efficient collection, processing, and use of wood and charcoal; creation of forest reserves; and introduction of windmills or solar energy devices. Since breakfast in Bara is eaten at 10:00 a.m. and dinner around 4:00 p.m. solar cookers might be feasible.

24. DOUGLAS, J. Sholto and Robert A. de J. Hart. 1976. Forest Farming. London: Watkins.

A general introduction to forest farming, including farm design, planting and cropping, choice of trees, and promising geographical areas for expansion. "First and foremost," tree farming offers possibilities for food production; nuts, fruits, oils, livestock fodder. Production of timber and environmental considerations are also important. Firewood is not mentioned.

25. DRAPER, S.A. 1977. Wood Processing and Utilization at the Village Level. Third FAO/SIDA Expert Consultation on Forestry for Local Community Development. December.

Proposes a package of systems for more effective wood use, including improved stoves. Notes that well-designed stoves use 40-65 percent of wood's energy potential, as opposed to 6-10 percent in the case of open fires. Even relatively simple stoves for use in developing areas could double the efficiency of firewood use. Such stoves have been tested in Indonesia, Guatemala, and India, although there is no evidence that they have actually been accepted by villagers in those countries. The World Bank is now financing trials of improved stoves as part of a rural development project in Tanzania.

26. DU BOIS, Victor D. 1974. The Drought in West Africa. American Universities Field Staff, West African Series, Vol. XV, No. 1.

27. EARL, Derek E. 1971. Madagascar: The Potential for Charcoal. Document FO:SF/MAG 8. Rome: FAO.

28. EARL, Derek E. 1972. Ivory Coast: The Place of Charcoal in the Economy. Geneva: ILO.

29. EARL, Derek E. 1974. A Report on Charcoal. Rome: FAO.

A viable charcoal industry is seen as a means of increasing the profitability of forestry. Emphasis is on industrial uses of

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charcoal. Experiments with a Mark V portable steel kiln in Uganda are reviewed, and suggestions are made for further research.

30. EARL, Derek E. 1975a. Forest Energy and Economic Development. Oxford: Clarendon Press.

Growing populations in developing countries will use greater amounts of fuelwood for cooking and heating. With urbanization, more of this wood will first be converted to charcoal, further increasing the pressure on forests. In addition, charcoal or methyl alcohol from wood will find a wider range of industrial applications as fossil fuels grow scarce. Fortunately, "the forests of the world are physically capable of sustaining supplies of fuel well above the basic energy needs of man," although expansion and sound use of these supplies will require governments to develop active forest energy policies. Notes the difficulty of using official statistics for policy-making, since these systematically understate forest use and do not reflect the wide variations in fuelwood consumption that often prevail in different regions or villages. In evaluating use of fuelwood vs. fossil fuels, the introduction of social ("shadow") prices for labor and foreign exchange will tend to increase the relative attractiveness of fuelwood projects.

31. EARL, Derek E. 1975b. "A Renewable Source of Fuel." In Unasylva, Vol. 27, No. 110.

An average hectare of tropical forest can be converted to 85 tons of fuelwood or 10-20 tons of charcoal. Systematic management of only 10 percent of their tropical forest could produce enough fuel for African countries to sustain 5 percent annual growth in total energy consumption for more than 20 years. In addition, forest programs provide income and a sense of self-reliance in needy rural areas. A major barrier to such programs has been the attitude that use of fuelwood is "primitive" and to be discouraged, but this attitude is changing as other energy sources become scarce.

32. ECKHOLM, Erik P. 1975. The Other Energy Crisis: Firewood. Worldwatch Paper 1. Washington, D.C.: Worldwatch Institute. September

Firewood supplies are being rapidly depleted in much of the Third World. This is a direct threat to the poor, since nine-tenths of the people in most of these countries depend on firewood for fuel. In addition, the accelerating degradation of woodlands leads to soil erosion, flooding, desertification, and declining soil fertility. These problems are further accentuated as people turn from wood to dung for fuel, robbing farmlands of the nutrients that dung has traditionally supplied. Massive tree-planting projects are called for, along with research into alternative energy sources such as solar cookers or biogas plants.

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33. ECKHOLM, Erik P. 1976. Losing Ground: Environmental Stress and World Food Prospects. New York: W.W. Norton & Co.

Includes chapters and extensive references on "A History of Deforestation" and "The Other Energy Crisis: Firewood."

34. ECKHOLM, Erik P. 1978. "Firewood: The Poor Man's Burden." In International Wildlife. May-June.

Notes the success of rural forestry schemes in China and South Korea. In both countries, strong local institutions have allowed extensive popular participation in project planning and implementation.

35. ERNST, Elizabeth. 1977. Fuel Consumption Among Rural Families in Upper Volta, West Africa. Ouagadougou: Peace Corps. July 5.

Results of a survey in two villages in Upper Volta. Millet stalks serve as the principal fuel for six months following the harvest. Wood is gathered for fuel during the remainder of the year, a process to which village women devote more than four hours each day. In the area surveyed, the morning meal is prepared before sunrise and the evening meal after sunset.

36. FLEURET, Patrick and Anne Fleuret. 1978. "Fuelwood Use in a Peasant Community." In Journal of Developing Areas. Forthcoming.

Results of a survey in one village in the Usambara Mountains of Tanzania. An average family of five uses 22.4 kg of wood each day for cooking and heating. This requires most village women to spend 6-12 hours per week making trips to the nearest forest reserve, in addition to time spent collecting twigs and branches nearby. During part of the year, charcoal may also be used for warmth during the night. Total wood consumption by the 200 people of the village is equivalent to 1360 acacia trees each year. Most cooking is done before 8:00 a.m. or after 5:00 p.m.

37. FOOD AND AGRICULTURE ORGANIZATION, Forestry and Forest Products Division (United Nations). 1967. Timber Trends and Prospects in Africa. Rome: FAO.

Includes a review of past fuelwood consumption, although major emphasis is on industrial uses of wood.

38. FOOD AND AGRICULTURE ORGANIZATION (United Nations). 1970. Savanna Forestry Research Station, Nigeria: Wood Requirements in the Savanna Region of Nigeria (based on the work of S. Thulin). Document FOR:SF/NIR 16, Technical Report 1. Rome: FAO.

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In Nigeria's savanna region, annual firewood consumption per capita is about 22 cubic feet, accounting for more than 90 percent of all wood consumed. Cornstalks and dung are also used for fuel. Total consumption of firewood in this area should increase from 785 million cubic feet in 1965 to between 865 and 1230 million cubic feet in 2000, or about 85 percent of all wood used.

39. FOOD AND AGRICULTURE ORGANIZATION (United Nations). 1971. Forest Industries Development Planning, Tanzania: Present Consumption and Future Requirements of Wood in Tanzania (based on the work of K. Openshaw). Document FO:SF/TAN.15, Technical Report 3. Rome: FAO.

Estimates that fuelwood accounted for 96 percent of all wood consumed in Tanzania during 1970. This estimate is based on household surveys and other sampling techniques, since official records cover only a small part of fuelwood actually produced. By the year 2000, combined consumption of firewood and charcoal could almost double, with charcoal's share of this total increasing from 3 percent in 1970 to 25 percent in 2000. Recommends that "considerable efforts" be made to develop accurate forest products statistics as a basis for development planning.

40. FOOD AND AGRICULTURE ORGANIZATION, Forest Resources Division (United Nations). 1975. Environmental Objectives in Forest Land Management. Rome: FAO. July.

Forests help provide pure air and water, more beautiful surroundings, and protection for wildlife. Unfortunately, these benefits are difficult to quantify, and we must often use "intuitive economics" to determine their value. To take adequate account of environmental aspects of forest activities, we should rely more on multidisciplinary planning teams, environmental impact analyses, and greater public involvement in the project design process.

41. FOOD AND AGRICULTURE ORGANIZATION (United Nations). 1976a. Wood for Energy. Rome: FAO.

42. FOOD AND AGRICULTURE ORGANIZATION (United Nations). 1976b. Yearbook of Forest Products 1963-1974. Rome: FAO.

Includes estimates by country of annual production of fuelwood and charcoal.

43. FOX, Gordon D. 1972. Forestry in Developing Countries: Potentials, Constraints, and Opportunities (Preliminary Survey). Washington, D.C. AID/TAB. October.

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Concentrates on commercial uses of timber. Major sections cover problems and solutions with respect to institutional and legal issues, transportation, information and research, and forest industries.

44. FOX, Gordon D. 1973. Technological Opportunities for Tropical Forestry Development. Washington, D.C.: AID/OST. November.

To promote industrial exploitation of wood products, reviews the potential of such technologies as aerial spraying, computerized sawing of logs, kraft pulping, radio communications, and portable lasers for cadastral surveys.

45. FREAS, Alan D. et. al. 1973. Factors Influencing the Utilization of Tropical Wood Species. Washington, D.C.: AID/OST. November.

Considers factors inhibiting use of secondary tree species for industrial purposes.

46. FRENCH, David. 1977. Appropriate Technology in Social Context: An Annotated Bibliography. Mt. Rainier, Maryland: VITA.

An introductory section notes that people for decades have been trying to transfer appropriate technologies in rural areas, as often as not unsuccessfully. Least successful have been attempts to introduce technology "softwares," or new ways of doing things. In general, failure has resulted from inattention to social context. To do better, aid donors or "change agents" will need to collaborate closely over time with people at the local level. Ultimately, success will depend on the existance of village institutions able to make technology choices and carry out technology activities.

47. FRENCH, David. 1978. "Energy for Africa's Future." In Africa Report, May-June.

Notes that in many African countries, more than four-fifths of all energy comes from noncommercial sources, especially firewood and charcoal. The pool of such material is becoming smaller, however, as deforestation proceeds at a rate that could leave Senegal bare of trees in 30 years, Ethiopia in 20, and Burundi in seven. Even considering other possibilities (oil, solar, etc.), reforestation will long remain the primary means for making energy available to Africa's scattered and largely rural population.

48. HORVATH, Ronald J. 1968. "Addis Ababa's Eucalyptus Forest." In Journal of Ethiopian Studies. January.

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49. INTERNATIONAL LABOR ORGANIZATION (United Nations). 1975. Charcoal-Making for Small-Scale Enterprises: An Illustrated Training Manual. Geneva: ILO.

50. JAMES, Corland L. 1964. Forestry Projects in Liberia. End of Tour Report, Project 669-11-170-002. Monrovia: USAID/Liberia. December 31.

Describes the status of an AID project in continuous existence since 1951. Specific activities include an inventory of forest resources, demarcation of protected national forests, strengthening of Liberia's Bureau of Forest and Wildlife Conservation, and promotion of forest products industries. Exclusive interest is in the timber potential of forest areas.

51. KIO, P.R. 1972. "Shifting Cultivation and Multiple Use of Forest Land in Nigeria." In Commonwealth Forestry Review. June.

52. KOEPPEN, Robert C. and S. Blair Hutchison. 1973. The Problem of Unbalanced Species Utilization in the Forests of Ghana and Nigeria as it Relates to the Need for Assistance in Determining the Properties of Lesser Used and Unused Species. Madison, Wisconsin: Forest Products Laboratory. November.

53. LANLY, J.P. 1969. "Regression de la foret dense en Cote d'Ivoire." In Bois et Forets des Tropiques. September-October.

54. LAURIE, M.V. 1974. Tree Planting Practices in African Savannas. FAO Forestry Development Paper No. 19. Rome: FAO.

Practical guidance for afforestation of savanna areas.

55. LITTLE, E.C.S. 1972. "A Kiln for Charcoal-Making in the Field." In Tropical Science, Vol. XIV, No. 3.

Describes a portable metal kiln able to convert scrub to charcoal in a 24-hour cycle. Field tests of the kiln were carried out in Kenya as part of an FAO/UNDP project.

56. MACKIE, Cynthia, ed. 1978. NRDC Tropical Moist Forests Conservation Bulletin (Number 1). Washington, D.C.: Natural Resources Defense Council. May.

Describes major institutions and programs working on protection and use of tropical moist forests. Includes both public and private groups, in the U.S. and abroad.

57. MAKHIJANI, Arjun. 1976. Energy Policy for the Rural Third World. London and Washington, D.C.: International Institute for Environment

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and Development. September.

Notes that improved stoves and utensils could economise on firewood, and proposes extensive research to develop such equipment.

58. McCOMB, A.L. and J.K. Jackson. 1969. "The Role of Tree Plantations in Savanna Development," In Unasyilva, Vol. 23(3), No. 94.

Concentrates on technical and economic aspects of tree plantations in Nigeria. Since trees grown in this way would be used for industrial purposes, most fuelwood would continue to be supplied from existing savanna woodlands.

59. NATIONAL ACADEMY OF SCIENCES. 1977a. Leucaena: Promising Forage and Tree Crop for the Tropics. Washington, D.C.: NAS.

Leucaena grows well in semiarid and savanna regions, as well as in more humid lowland tropics. It coppices readily and can be harvested for firewood in cycles as short as 3-10 years. In addition, leucaena can be used for timber, fertilizer, and forage.

60. NATIONAL ACADEMY OF SCIENCES. 1977b. Resource Sensing From Space: Prospects for Developing Countries. Washington, D.C.: NAS.

Describes available and projected systems for remote sensing of crop yields, erosion, alterations in land use, and other environmental changes. Outlines uses already made of satellite data for studying earth resources.

61. OPENSHAW, Keith. 1974. "Wood Fuels the Developing World." In New Scientist. January 31.

62. OPENSHAW, Keith. 1976. Woodfuel--A Time for Re-Assessment. (Stencil No. 300.) Morogoro, Tanzania: University of Dar-es-Salaam September.

Higher petroleum prices may contribute to increased use of fuelwood and charcoal. For household uses alone, demand for wood in developing countries may grow by 1.5-2.0 percent annually. In order for governments to plan the fuelwood plantations and village woodlots required to meet rising demand, wood consumption and resource surveys are needed. With respect to charcoal production, Openshaw notes that both overall costs and wood requirements per ton can be reduced by as much as 50 percent by using manufactured kilns in place of traditional conversion methods.

63. OPENSHAW, Keith. 1977. "Woodfuel--A Time for Reassessment." In East African Journal. January.

64. PEARSON, Scott R. 1974. Concession, Royalty, and Tax Policies for

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Ghanaian Timber. Stanford, California: Food Research Institute.  
April.

Prepared for USAID/Ghana, this report investigates policies through which the Ghanaian Government could capture the "economic rent" associated with exploitation of timber resources by private companies.

65. POOLE, Alan. 1977. Energy From Biomass: A Conceptual Overview. Study prepared for ERDA/APAE. Washington, D.C.: Institute for Energy Analysis/Oak Ridge Associated Universities. September 30.

Includes a major section on "Bioenergy in Underdeveloped Countries." Such countries have great need for bioenergy (most notably for firewood) along with great potential for supplying this (due to high yields of biomass systems in tropical and subtropical regions). Biomass is also attractive for LDCs since its production is relatively labor-intensive.

66. POWELL, John W. 1978. "Wood Waste as an Energy Source in Ghana." In Norman L. Brown ed., Renewable Energy Resources and Rural Applications in the Developing World (AAAS Selected Symposium 6). Boulder, Colorado: Westview Press.

The potential power output of Ghana's wood wastes is greater than current national power consumption. Full use of wastes produced in forests by logging and land clearing will be economically feasible only when the cost of firewood rises substantially. Of greater value now may be the estimated 25,500 tons of sawdust produced annually by Ghana's sawmills, more than half of which are concentrated in the Kumasi area. A pyrolytic converter to make charcoal from sawdust is being tested in Kumasi by the Georgia Institute of Technology. Ghana's Department of Forestry has also tested a number of kilns for converting wood to charcoal. Although the best of these (the Tranchant kiln) is 2-3 times as efficient as traditional methods, its relative complexity and high cost have kept it from being widely adopted.

67. RAPP, Anders. 1974. A Review of Desertization in Africa--Water, Vegetation, and Man. SIES Report No. 1. Stockholm: Secretariat for International Ecology.

68. REVELLE, Roger. 1975. "Energy and Rural Development." In Georgia Institute of Technology, Economic Development Laboratory, Discussion Papers on the Problems of Science and Technology. Atlanta: Georgia Institute of Technology. December.

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Energy use in developing countries is already considerable, but conversion processes are quite inefficient. In the short run, improved stoves can conserve firewood for cooking or water heating. Over the longer term, there may be promise in rapidly growing tree species, along with the use of biogas or solar technologies.

69. ROCHE, Laurence. 1974. Major Trends and Issues in Forestry Education in Africa: A View from Ibadan. Bulletin 4, Department of Forest Resources Management. Ibadan: University of Ibadan.

70. SANGER, Clyde. 1977. Trees for People: An Account of the Forestry Research Program Supported by the International Development Research Centre. Ottawa: IDRC.

Discusses a series of IDRC fuelwood projects, including establishment of village woodlots in Niger, species and yield trials for irrigated forest plantations in Mali, and afforestation of marginal lands in Kenya. The IDRC is also supporting a three-member forestry team, based in Nairobi, to serve a number of African countries. Among other tasks, this team will supervise preparation of state-of-the-art papers covering forestry research in Africa.

71. SARTORIUS, Peter and Hans Henle. 1968. Forestry and Economic Development. New York: Praeger.

72. SKOLD, P. 1970. Present and Future Wood Demand and Supply--Kenya. Rome: FAO.

A general survey, including estimates of domestic fuelwood consumption.

73. TATOM, John W. 1976. Clean Fuels from Agricultural and Forestry Waste Atlanta: Georgia Institute of Technology, Engineering Experiment Station. October.

74. TATOM, John W. 1977. Demonstration of Alternative Fuel Production through Pyrolysis of Agricultural Wastes at the UNEP Rural Energy Center in Senegal. November.

Describes technologies for pyrolytic conversion of agricultural wastes (rice, straw, peanut hulls, bagasse, cotton gin trash, etc.) to charcoal, oil, and gas. Assuming that suitable stoves are available to use the pyrolytic oil, these systems can increase by about 2.5 times the amount of useful energy from a given amount of biomass. Proposes a converter to process one ton of peanut hulls per day as part of a UNEP rural energy center in Senegal.

75. UHART, Edmond. 1975. Charcoal in the Sahelian Zone. Addis Ababa:

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75. UHART, Edmond. 1975. Charcoal in the Sahelian Zone. Addis Ababa: U.N. Economic Commission for Africa. July.

Estimates that half of the Sahel's urban population uses charcoal, at a per capita rate of 15 kg per month. In Upper Volta, a family of five now spends about \$156 annually for charcoal. To maintain an adequate charcoal supply, eucalyptus plantations should be planted within 50-80 km of urban centers; existing stands of trees should be protected; use of metal or masonry charcoal kilns should be encouraged; and new charcoal production should be considered in heavily forested areas up to 200 km from major markets. For the Sahel (Chad, Upper Volta, Mali, Mauritania, Niger and Senegal), the cost of an adequate firewood plantation program alone would be about \$27 million annually, or enough to plant 390,000 hectares over a ten-year period.

76. UHART, Edmond. 1976a. Charcoal Industry in the Sudan. Addis Ababa: U.N. Economic Commission for Africa. January.

An earlier survey estimated per capita fuelwood consumption in the Sudan to be 1.6 m<sup>3</sup> in 1960. This seems too high, and a new survey should be carried out. To help meet charcoal needs in major towns, 60,000 ha should be planted with fast growing tree species on irrigated land in Gezira and Blue Nile Provinces, at a total cost of about \$6 million. Several types of fixed masonry kilns could be built nearby: Katugo (about \$1,000 each), Missouri (\$2,000), or Beehive (\$1,000-2,000). Between 50,000 and 60,000 tons of charcoal could be produced annually through such a project.

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- 77. UHART, Edmond. 1976b. Charcoal Problem in Somalia. Addis Ababa: U.N. Economic Commission for Africa. February.
- 78. UHART, Edmond. 1976c. Le charbon de bois a Madagascar. Addis Ababa: U.N. Economic Commission for Africa. September.
- 79. WALTON, J.D., Jr., A.H. Roy, and S.H. Bomar, Jr. 1978. A State of the Art Survey of Solar Powered Irrigation Pumps, Solar Cookers, and Wood Burning Stoves for Use in Sub-Sahara Africa. Atlanta: Georgia Institute of Technology, Engineering Experiment Station. January.

With respect to wood stoves, provides references to about ten miscellaneous publications. Of these, only a report by the Brace Research Institute includes a prototype for use in developing countries, and this has not yet been field tested. Concludes with a proposal by the authors for experimentation with a stove of their own design, to be constructed from a 5-gallon paint can for less than \$5.

- 80. WEBER, Fred R. 1976. The Role of Forests in Sahelian Rehabilitation Efforts. (Report on CILSS/UNSO/FAO conference, Dakar, 26 April - 1 May 1976).

Summarizes technical papers by outside experts and country reports by forestry officials from Cape Verde, Gambia, Mali, Niger, Upper Volta, Senegal, Chad, and Mauritania. Concludes that urgent forestry needs in the Sahel require action particularly in the areas of administration (forest services should be strengthened and given a greater voice in development planning), education (for forest service personnel as well as farmers and herders), and research.

- 81. WEBER, Fred R. 1977a. Reforestation in Arid Lands. Mt. Rainier, Maryland (VITA) and Washington, D.C. (ACTION/Peace Corps).

Practical guidance for carrying out local reforestation projects, with emphasis on conditions in West Africa. Covers general issues

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in project planning, as well as specifics of selecting tree species (in line with environmental constraints, purposes of the project, and human factors); choosing among planting techniques (direct seeding, cuttings, nurseries); managing nurseries; preparing and using the planting site. Appendixes provide information on tree species, climate, and soils in West Africa.

82. WEBER, Fred R. 1977b. Economic and Ecologic Criteria: Proposed Club des Amis du Sahel Forestry/Anti-Desertification Program. Report for AID/AFR/SFWA. May.

Background material for considering forestry programs in the Sahel, including areas of greatest fuelwood need, local prices for wood and charcoal, costs of forest plantations, specific problems of various climate zones, and criteria for project evaluation. Notes that tree projects normally cost \$565-725 per hectare for planting and maintenance through the first year. When care in later years is included, along with cutting and stacking of wood, the total cost of firewood from these projects is about \$10 per ton, versus average current prices "at source" of about \$6 per ton. While such plantations are of high priority in southern areas of the Sahel, northern zones have greater need for projects to protect existing vegetative cover. Unfortunately for all these efforts, no Sahelian country yet has an effective forest management program. In defining and mobilizing support for forestry programs, a first need is for good communication among managers, technicians, and bureaucrats (Sahelian and foreign), as well as local farmers and herders.

83. WEBER, Fred R. 1977c. Sahel Peace Corps Director Workshop Report. Report to Peace Corps. December 28.

Only 31 of 500 Peace Corps Volunteers in the Sahel are working on forestry activities, although CILSS and the Club du Sahel have declared this a priority area. Given proper administrative arrangements and adequate funding, large numbers of additional PCVs could usefully be put to work on such projects as vegetation surveys, forest reserve management plans, village woodlots, regional nurseries, and training of local technicians.

84. WELLWOOD, R.W. 1966. Report to the Government of Nigeria on Forest Industries. Rome: FAO.

Concludes that use of secondary species is essential if timber is to contribute adequately to Nigeria's development.

85. WESTOBY, Jack C. 1975. "Making Trees Serve People." In Commonwealth Forestry Review 54, 3/4.

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Reviews world forestry experience over the past twenty years. Much international aid to developing countries has served primarily to help foreign interests exploit local timber resources. In contrast, the contribution of forestry to the well-being of the poor has been negligible. To make such a contribution in the future will require a commitment of resources and personnel well beyond the capacity of forest services and aid agencies. Progress can be made only if energies of the people are mobilized for cooperative effort.

86. WORLD BANK. 1978. Forestry: Sector Policy Paper. Washington, D.C.: World Bank. February.

Forests in developing countries are being consumed for agricultural settlement and fuelwood at a rate that could lead to their disappearance within 40 years. Affected most directly are the 200 million people who live in or near forests. The Bank intends to modify its traditional emphasis on industrial forestry by financing more "people-oriented" projects, including village woodlots and other "rural development forestry" activities. Of \$800 million in forestry and paper industry loans over the next five years, the Bank should allocate about \$300 million to projects in rural areas, including environmental forestry; rural afforestation; establishment of timber, pulpwood and fuelwood plantations; institution building; training and research; and support for small industries using wood. Major research activities will include field crop trials, studies of the availability and cost of alternative fuels, and a search for more efficient systems for wood burning, heating, and cooking.

APPENDIX A

Firewood Conversions

CE (Coal Equivalent) -- energy equivalent of 1 metric ton of coal = approx. 2.3 m<sup>3</sup> dry fuelwood.

CV (Calorific Value) -- number of kilocalories produced by burning 1 gram of:

- fuel oil 9.8
- charcoal 5.8 - 7.9
- coal 6.9
- oven dry wood 4.7
- dry cow dung 4.0
- air dry wood 3.5 - 3.8  
(20-30% m.c.)

1 stere = 1 m<sup>3</sup> stacked wood = approx. 400 - 435 kg.

1 m<sup>3</sup> stacked wood = approx. 0.58 m<sup>3</sup> solid wood.

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1 m<sup>3</sup> solid wood = approx. 700 - 750 kg.

1 cord = 128 ft<sup>3</sup> (3.6 m<sup>3</sup>) stacked wood = 2.12

1 hectare (ha) = 2.47 acres.

1 ha of firewood plantation (Sahel) yields approx. 10 steres/year, or enough to meet the needs of about 6.25 people.

100 kg of wood yields 8-25 kg of charcoal, depending on conversion method.

CV of 1 kg charcoal = CV of approx. 2 kg wood (air dry).

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LIST A FOR AID AIRGRAMS AND TELEGRAMS S. ND 20:

LIST A

- 5 ABIDJAN
- 4 ACCRA
- 5 ADDIS ABABA
- 2 BAKO
- 2 BISSAU
- 2 BUJUMBURA
- 1 CONAKRY
- 1 COTONOU
- 4 DAKAR
- 4 DAR ES SALAAM
- 2 DJIBOUTI
- 1 FREETOWN
- 2 GABORONE
- 3 KHARTOUM
- 2 KIGALI
- 5 KINSHASA
- 2 LAGOS
- 2 LILONGWE
- 2 LUSAKA
- 2 MASERU
- 2 MBABANE
- 3 MOGADISCIO
- 5 MONROVIA
- 12 NAIROBI
- 3 NDJAMENA
- 3 NIAMEY
- 2 NOUAKCHOTT
- 2 OUAGADOUGOU
- 4 YAOUNDE
- 1 LOME

CAPTIONS

- 3 DAKAR FOR RDO AND OMVS COORD
- 2 NAIROBI FOR USAID AND REDSO/EA

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CLASSIFICATION

30 POSTS (31 & 91 CYS W/CAPTIONS)

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