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Kenya Renewable Energy Development Project:

Mid-Term Evaluation

Prepared for United States  
Agency for International Development  
Kenya Mission

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## PREFACE

The plan of the Evaluation Mission called for a three-man team, one of whom, Dr. Little, was to complete his work on November 4; one of whom, Mr. Evans, was to complete his work on November 8, and one of whom, the Team Leader, Mr. Kernan, was to complete his work on December 10. With some adjustments, the team has adhered to that schedule.

Because the plan as outlined above did not provide for joint preparation, review and final agreement by the team members, the report is presented in three parts. Parts II and III were prepared by Dr. Little and Mr. Evans respectively. In preparing Part I, the Team Leader has drawn upon Parts II and III for facts, ideas and suggestions, and has endeavored to present a coherent whole in Part I, using his own judgment without suppressing those of the other members.

The form of the Evaluation Report results from four directives. They are the Project Evaluation Summary (PES), the Statement of Work, the Evaluation Questions, and the Logical Framework. Answering these different directives has required considerable repetition.

## Table of Contents

	Page
Part I	Project Evaluation Overview
1.0	Project Evaluation Summary (PES) 1
2.0	Project Status 12
3.0	Analysis of Project Strategy 50
4.0	Barriers and Constraints 53
Part II	The Agroforestry Centers
1.0	Introduction 59
2.0	The Appropriateness of Center Selection and the Agroforestry Approach 60
3.0	Research 63
4.0	Extension and Farmer Outreach 67
5.0	Training 71
6.0	Integration with Farming Systems 72
7.0	Center Management and Coordination 74
8.0	Summary of Recommendations and Priorities for Future Activities at the Agro- forestry Centers 77
Part III	Cookstoves and Fuel Production
1.0	Introduction 79
2.0	Charcoal Stoves 80
3.0	Woodburning Stoves 88
4.0	Charcoal Production 91
5.0	Final Remarks 95
6.0	Summary of Conclusions 98
Part IV	Evaluation Conclusions and Recommendations
1.0	Conclusions 100
2.0	Recommendations 101
Appendices	
I	Itineraries 106
II	Bibliographies of Principal Documents Consulted 108
III	Principal Contacts 115
IV	Geographic Coverage of Cookstove Evaluation 117
V	Organizations Visited with Capabilities in Improved Stoves 119
VI	Evaluation Questions 120

## 1.0 Project Evaluation Summary (PES)

1.1. Background. Three years after the signing of the Project Grant Agreement and two years after the start of operations, the project structure is in place, the last of the commodities to be provided are on order and expected soon, the six agroforestry centers and one sub-center are established and operating in research, demonstration, training, growing and selling seeds and seedlings. The project has produced and disseminated an excellent charcoal stove and achieved some notable progress in energy conservation and policy planning. The principal hindrances have been:

- GOK and AID procedures for procurement, recruitment and disbursement of funds;
- The three-month delay because support to the Beijer Institute did not take the form specified in the Project Paper; and
- The late arrival of commodities.

The project has made notable progress toward achieving its goals. The GOK has given official recognition to project activities in its Draft Energy Policy Document (Ref. 38), in whose preparation the project staff participated.

The prospects are that after a phased withdrawal of AID support and a phased assumption of project activities by the GOK, the capability of the Ministry of Energy and Regional Development to handle the duties assigned to it will have been sufficiently enhanced to justify further donor support.

1.2. Evaluation Methodology. Section VI (A) of the Project Paper states the reason and emphasis of the present evaluation. During the stages of demonstration and dissemination, the feasibility

of the technologies proposed and their potential for wider distribution are more significant for evaluation than their impact upon the well-being of the community. Except for charcoal stoves and fuel conservation, the project has not yet moved deeply into the demonstration and dissemination stages. It has thus far been concerned principally with preparing the physical and administrative setting for those stages. For that reason the evaluation and monitoring plan which Section VI(A) outlines has proved too detailed and has not been carried out.

The present evaluation is the mid-term review for which Annex 1 of the Project Grant Agreement provides on page 8. The Evaluation Team has drawn upon field visits, discussions with individuals, and documents as noted in Appendices I, II and III of this report. The team consisted of three specialists, one each in forestry, anthropology and cookstoves. The last two prepared reports on their specialties. The forester and team leader has drawn upon their reports to prepare the main body of the evaluation. Because of their early departure it was not possible to prepare a document jointly.

1.3. External Factors. This project had its genesis in the energy situation of the late 1970's. The rising cost of imported petroleum, the decline in export prices for agricultural products to pay for petroleum, and projections of rapid population increase caused alarm and a sense of crisis. Indicated for attention were continued monitoring of the energy balance, fuel conservation, and the wood resource upon which most of the population draws for energy needs.

The project reflects these concerns in three principal components. Because most of the population which uses firewood lives in the high-potential agricultural areas, the wood resource component was directed primarily to that target group. Since project inception, three circumstances have come about which have a bearing upon the project.

First, the atmosphere of crisis which generated the project has somewhat eased. Petroleum prices have not increased as rapidly as feared. This circumstance may influence the amount of budgetary support which the Government is willing to devote to other energy sources. The concern has eased because oil prices have dropped from \$33 to \$29 a barrel, even though the burden of oil imports has increased from 36 percent of net export earnings in 1980 to 60 percent in 1982. (Personal Communication from Mike Jones, EDI Project Staff).

Second, the continued migration to and growth of cities foreshadow a greater use of charcoal in proportion to firewood. For that reason the Evaluation Mission has suggested that henceforth more project attention be given to the marketing, production and sources of charcoal such as fuelwood plantations, and to management of the savannah woodlands.

Third, a budgetary crisis occurred in March, 1983. Austerity measures were embodied in a directive of the Ministry of Finance and Planning to all Ministries with new project commitments. The Ministry of Energy met the situation by allowing the EDI contract to spend project funds and by seeking an advance payment from AJD. The advance payment of KSh. 976,000 was released in June 1983.

1.4. Inputs. The problem with commodities has arisen principally

because of slow and cumbersome procurement procedures. Twenty-six months after the start of operations, the project is still waiting for five jeeps, 30 motorcycles, 36 bicycles and the Wang computer. Presumably such commodities as are included in the project agreement's Illustrative Financial Plan (Annex 4) are considered essential to its progress and success. The late arrival of mobile equipment has particularly hindered the project from moving into the phases of extension and dissemination, as called for in the Project Paper.

The project has carried a heavier administrative load than envisaged, because the counterpart ministry has been unable to give sufficient administrative support. The administrative responsibilities of the technical staff have hampered the input of technical services.

With regard to training, the problem has been the availability and willingness of candidates to attend short-term training courses under the project.

1.5. Outputs. Annex 2 of the Project Grant Agreement contains a detailed listing of project activities with a target date for each. In general, the project activities are about two years behind the target dates. A listing by groups and a brief comment on each follow:

(A) Initial Planning and Surveys

- (1) LEAP Model. It is not yet operative in the country but has produced one energy print-out and trained two operators.
- (2) Technical Assistance. It was begun October 1981, four months behind schedule. It is effective but burdened with administrative duties.



(3) Energy Data Bank and Library. It is still in the U.S.

(B) Institutional Development

(1) Fuelwood/Agroforestry. Six agroforestry centers and one sub-center are operating with nurseries, seed orchards, research, demonstration plots, stove artisans, and programs in training, extension and research.

(2) Cookstoves. The long-term technical advisor's contract is about to terminate. The program is one year late but very successful. Twenty artisans have been trained.

(3) Charcoal. A decision by GOK postponed this program.

(4) Community Water Supply and Irrigation. A decision by GOK eliminated this program. The water conservation engineer was not recruited.

(C) Applied Research and Demonstration

(1) Agroforestry Centers. All six centers are conducting applied research and demonstration.

(2) Energy Development Fund. No progress has been made. First grant award made 18 months behind schedule and not yet accounted for.

(D) Monitoring and Evaluation

Mid-Term Project Evaluation Report. It was prepared in November 1983 rather than December 1982 as specified in Annex 2.

1.6 Purpose. "The specific purpose of the project is to establish a capability in the Ministry of Energy [and Regional Development]

to formulate policy and to plan, oversee implementation of, and provide technical assistance to, monitor and evaluate renewable energy programs and energy conservation measures in all sectors of the economy."

(Ref. 10 P. II-5).

The project's logical framework has the following six indicators:

(A) Energy audits, surveys, training and recommendations are improving efficient use of petroleum. An improved stove is saving quantities of charcoal. No action has been taken on charcoal kilns and wood stoves.

(B) Through a project-supported contractor, MOE is providing energy-related technical support to other government and private entities.

(C) MOE is operating six nursery/extension centers and one sub-center as agencies for technology transfers on afforestation and agroforestry techniques. They are appropriate to the goal of reaching the greatest number of rural people. They are not appropriate to the goal of forest management.

(D) The Energy Development Fund has not been effective. The Mission suggests a different approach towards stimulating private enterprise to apply conservation-related techniques rather than exclusive use for extension and demonstration.

(E) The project now has the capability of demonstrating energy technologies and extension methods and is transferring the skills to counterpart personnel needed for the systematic evaluation of these technologies and methods. The capability is being transmitted and is being established in MOE so as to ensure

satisfactory coordination of project activities after PACD and integration into new and existing programs.

(F) Through the LEAP model, the Ministry has an increased capability to formulate and establish a national energy policy. The Draft Energy Policy Document's section on woodfuel development policy is largely built upon the LEAP model (Ref. 38).

1.7 Goals/Subgoals. The project's goals are two:

- to reduce the adverse impact of fossil fuel imports on Kenya's balance of payments, and
- to make progress in achieving a balance of wood supply and demand (Ref. 10, P. II-5).

Through the project's fuel conservation program the Ministry has gained a significant and growing capability to suggest and monitor petroleum conservation. To achieve measurable progress will require an innovative approach, such as the Energy Development Fund. However, petroleum conservation does not appear among the priorities listed for the Energy Development Fund in Annex 4 of the Project Paper. The Mission has therefore suggested a re-direction of that fund toward more emphasis upon energy-related private industrial proposals, including petroleum.

The national enthusiasm for tree planting has noticeably increased since the energy crisis of the late 1970's. The project's contribution has been to promote the planting of trees with agricultural crops, a technique aimed more at overall farm betterment than at improving the balance of wood supply and demand. For this reason the Evaluation Mission has suggested<sup>d</sup> that the project give attention as well to options other than agroforestry which can have a more

measurable influence upon that balance.

1.8. Beneficiaries. Section 102(b) of the Foreign Assistance Act of 1961 as Amended Item (5) mentions nutrition as a critical problem in countries to which bilateral assistance is directed. Item (7) states that the prosperity and the development of developing countries require the adoption of an overall energy strategy.

The agroforestry and cookstove aspects of this project aim primarily to bring about better nutrition among the rural and urban poor. The vast majority use wood and charcoal to cook their food. Those without sufficient fuel eat more raw (and hence unsanitary) foods, undercooked foods, and choose less nutritious diets that require less cooking. For such reasons an adequate supply of fuel has a direct link to nutrition and health. Moreover the project has encouraged the planting of fruit and fodder trees because even in drought years they produce food. They also mature at the low point of the yearly nutritional cycle.

The availability of fuel has a direct effect upon agricultural productivity in two ways. First, women, who provide much of the agricultural labor, can spend less time collecting wood when fuel is available. In effect, they have more time to devote to other activities under favorable fuelwood conditions. Second, the presence of well-chosen and well-placed trees can increase productivity by improving the tilth and fertility of the soil, increasing the infiltration rate of water, obviating the use of agricultural residues for fuel, and decreasing radiation and soil temperature by casting shade. (Ref.43)

The survey and planning components of this project have been influential in the preparation of the Draft Energy Policy Document of the Government of Kenya (Ref. 38). The LEAP model is capable of a continuing contribution to up-dating and modifying that policy in view of changing circumstances.

1.9. Unplanned Effects. Not pertinent at this time.

1.10. Lessons Learned. Below are listed several important ways the project could have been made more effective.

(A) The genesis of this project lies with the energy crisis of the 1970's and GOK's concern with foreign exchange and the demand-supply situation of the wood resource. Those problems are national problems, but of little concern to the rural poor. An approach more appealing to them is the positive one of better farming methods rather than the negative one of resource conservation. If the project had been designed from their point of view it would have given greater emphasis to women's role in farming and cooking and would have addressed itself more to problems important to the target groups (the rural and urban poor) rather than to problems of concern to finance and planning.

(B) The project is complicated and over-designed for a new and weak Ministry which did not have a structure until one year after the start of operations, or a division (Biomass) in which to place the project. The project staff has had to deal with three Ministers and three Permanent Secretaries in two years. The Ministry is now undergoing yet another re-organ-

ization

(C) The project should have separated the administrative and technical functions of the team leader and proceeded by stages whereby ample time could have been given for commodities to arrive, administrative procedures to be worked out, and the counterparts to be in place before the technical staff members' arrival.

1.11 Special Comments or Remarks. The Mission finds the Project Paper to be unnecessarily lengthy and detailed. A presentation of massive repetition does not serve to bring into focus the problem and proposed solutions. The Project Paper discusses in detail techniques, such as solar pumps and pyrolysis, that are inconsequential to the project's success. The implementation schedule is overly detailed and has too rigid a time schedule. The Project Paper has locked the staff into an unrealistic and overly-complicated framework of dates and components which do not allow for structural adjustments in the counterpart ministry.

The Mission finds both the handling of support to the Beijer Institute and the contract to Clark University to be ambiguous (discussed in more detail in Section 2). Support to the Beijer Institute has not resulted in a definitive final report. The one available summary document is an undated draft and confidential discussion document (Ref. 2) which the Inter-Ministerial Working Party on Energy severely criticized in a report of March, 1982 (Ref. 21)

and whose revision has not taken place.

The Clark contract (discussed in Section 2), on the other hand, did not assist the project staff in any substantive way and did not provide USAID/Kenya with five copies of the contractor's report as stipulated. Unlike the Beijer document, the Clark report is a confidential draft that was not available to the project staff and the Evaluation Mission.

The principle means of carrying out this project is a host country contract between the Government of Kenya and Energy Development/International, Inc., which leaves most of the initiative for action up to the former. It assumes that the Government can and will provide the funds and resources required to carry out the project effectively and in a timely manner as stipulated in Section 3.3. of the Project Grant Agreement. The Government has not provided such funds and resources, and the contractor is in no position to force such provision. Government procedures for recruitment, procurement and disbursement are not such as to carry out the project effectively and in a timely manner. The contractor has not received sufficient support therefore as regards office space, clerical and secretarial help, transport, and counterpart personnel. The minutiae of governmental procedures have held up minor purchases for months. Either the contractor should have responsibility and funds to deal with such matters, or the USAID and GOK should set goals and target dates to conform to their own capacities to disburse funds.

Finally, the Mission finds a certain divergence between the project's goals and purpose. The latter concerns governmental

matters and their relations with the public. On the other hand, the goals seek the application of technologies, several of which are inappropriate to governmental institutions and inadequately handled by them. They need and should have stronger links with private enterprise and non-governmental organizations than the Project Paper envisaged.

## 2.0 Project Status

2.1 Planning and Surveys. The Project Paper's Summary, dated August 1980, contains a paragraph entitled "Initial Planning and Surveys." It describes the assistance to be provided in helping to install energy information systems, thereby developing and implementing national policies and programs that relate to efficient use of wood and petroleum-based fuels. Annex D, paragraph two, contains a short discussion of the assistance and the following statement: "...it is important that MOE be able to monitor energy consumption patterns in all sections."

In total, the project has obligated \$537,658 to this component, of which \$438,508 remained unliquidated as of 10/12/83. A Wang U.S.45 computer is on order and will be installed by January 1984 in Kenya. The model for the computer study presently is with the Energy Systems Research Group in Boston USA with which the Ministry has a contract. The computer system is intended to support the Planning and Development Division of the Ministry of Energy and Regional Development and become a module of the national economic model already in operation.

The facility is intended to operate in cooperation with the



Census Department of the Central Bureau of Statistics (Ministry of Finance and Planning), the Kenya Rangeland Ecological Monitoring Unit and the Regional Remote Sensing Facility. The purpose is to conduct a continuous survey of the energy supply and demand situation in Kenya.

The potential long-range usefulness of a continuous survey is not at issue. The realization depends upon the quality of the data which the computer processes and the extent to which the results are effectively employed in shaping policies. Data on imported fuels and electricity are relatively accurate and easy to collect and interpret. Changes in biomass production and consumption of fuel are more difficult to monitor and interpret. The Beijer/Clark Fuelwood Study (Element 6 of Comprehensive Pipeline Report as of 10/12/83) began to develop in the Ministry the capability for collecting and interpreting such data. A contract with the Energy Systems Research Group has trained two Ministry employees in the use of the Wang computer. To make use of this facility, a long-term (through December 1984) training and general service contract with ESRG is needed. The funding cost is estimated to be \$138,000. The Planning and Development Division will use the six agroforestry centers as focal points for collecting biomass data (Personal Communication Lincoln Bailey, MOE&RD).

The Project Implementation Schedule of the Project Paper (Table V-1 Section A) calls for the computer to be installed in February 1981 and for the Final AL-EDIS Report two months later. That model has been replaced by the LEAP (Less-developed Country Energy Plan-

ning) model. The activity is thus three years behind schedule.

Furthermore, the Project Draft Workplan (Ref. 11) dated January 22, 1982, has the following statement: "Substantial effort has been expended by Clark University and the Beijer Institute Team in assembling existing data, performing urban and rural energy use surveys, and developing an energy flow and fuelwood planning model. Unfortunately, much of this work has yet to be written up and/or completed, and therefore cannot be thoroughly reviewed for several months."

As of December 1983 the Beijer Institute's draft discussion document (Ref. 2) was available; but the Institute had not yet produced a definitive report.

The paragraph quoted above refers to the Beijer/Clark Fuelwood Study which appears in Element 6 of the Project Pipeline Report and has allocated to it \$249,150 but which does not appear in the Project Paper, and is not clearly stated in Annex I of the Project Agreement. A sub-contract from the Beijer Institute to Clark University dated September 1981 provided for that study. The sum of \$99,150 was disbursed in an invoice dated July 7, 1982. Payment was made on the basis of a letter of June 4, 1982, addressed to the Director, USAID, and signed over the designation of the Ministry's Permanent Secretary. The letter stated that the work called for had been satisfactorily performed.

The Beijer/Clark Contract dated September 1981 for which the Project paid \$99,150 stipulates eleven services to be performed (Article V) and five copies of progress reports of each task as

completed and five copies of the final report (Article VIII).

Undated confidential and preliminary copies of that report are with the Ministry. The services performed, however, have been only of limited value thus far in advancing the project objectives, because the model which the contractor designed is not yet installed and operating in Kenya, and because the assistance to the contract staff which the contract's Plan of Work (Article 5) calls for in items 3, 4, 8 and 9 was not made available to the project staff.

Poor communications between the Ministry's Planning and Development Division and the Biomass Division impaired the usefulness of this contract.

The Beijer/Clark Fuelwood Study replaced the technical assistance recommended by the Project Paper (Annex VB.2) and described on pages 13 and 14 of attachment 1. The displaced assistance was to have provided the Ministry of Energy with Fuelwood/Agroforestry Demonstration Center Implementation Assistance. The assistance was to have consisted of:

- (1) Identification of the Agroforestry Centers' sites,
- (2) Preparation of work plans for each, and
- (3) Preparation of budgets for each.

In October 1981 the main contractor's (Energy Development/International, Inc.) project staff members arrived in Nairobi three months after the date contemplated in the Project Paper. Instead of finding the above assistance provided, they were faced with having to carry out the work, though their contract did not provide for it. This factor caused at least an additional three-months' delay in

project operations, and is a valid reason for considering the project's extension.

Section V, Item B, of the Project Paper Implementation Schedule, No.2, entitled Beijer Implementation Planning Assistance, contains the following sentences: "Beijer will assist the MOE in implementation planning for the fuelwood/afforestation centers project component. Beijer will assist in site identification and selection, species/seed identification and selection, preparation of site-specific cost estimates and implementation plans...."

In addition, Annex IB, Project Components Item 1, contains the following paragraph: "...the Project will provide additional funding to Beijer Institute to survey general land tenure patterns, identifying possibly underutilized lands (particularly those within 50 kilometers of Nairobi), and analyze incentives to promote production on underutilized private or County Council lands."

Neither the above assistance nor the funding was provided. At this point, to make planning more effective, the parties to the Project Agreement should consider appointing the Deputy Permanent Secretary for Planning and Development as project coordinator in the Ministry of Energy and Regional Development.

2.2 Fuelwood and Forestry. Tree species research and nursery operations at the six agroforestry center nurseries and the one sub-center nursery are still being established. They have so far included but not concentrated upon fuelwood species. Seed availability has been one factor accounting for this circumstance. Another is the lack of clarity as to the purpose of the nurseries. Are they seeking to promote

trees for energy, or are they seeking multiple-purpose trees that fit into the general purposes of the farm enterprise? Nursery managers state that farmers give first attention to those species with which they are familiar, and to the more immediate purposes of food and fodder and to boundaries, posts and poles. Rural landowners who are in a position to plant trees generally do not perceive of a scarcity of wood for fuel. Their landless neighbors are more likely to perceive such scarcities; but agroforestry's primary concern is not with the landless.

Since other nurseries exist for multiple-purpose trees, the Evaluation Mission suggests that species research at the centers be directed more toward fuelwood species which fit in well with agricultural crops and animal husbandry. In addition, efforts should be made to develop regular markets for wood, so that farmers will perceive trees as a source of cash income.

Because the nurseries are in the early stages of development, they have not as yet made complete cost estimates for seedlings production and distribution. The project should establish a rigorous cost-accounting system as part of the research effort. The policy of distributing seedlings at a price of .08 Kshillings follows that of the Forest Department but has no evident connection with the cost of providing them. The preliminary cost estimates are as high as five shillings per seedling, with the average around 1.50 shillings. It is likely, however, that small nurseries without overhead could produce them for .50 shillings apiece.

The agroforestry centers have not had the means or the time to

make sufficient survival counts to arrive at statistically relevant figures. The consensus is that survival rates are unsatisfactory, but could be raised with better distribution and post-planting care. Kenyans who spend their lives planting and caring for crops surely know how to plant and care for seedling trees. However, in comparison with some other African countries, reforestation in Kenya is difficult because of the vagaries of the weather. If farmers raised the seedlings themselves, they might take a greater interest in their survival. They also would be more concerned if they paid more than a token amount for them.

The Mission therefore suggests that the price of seedlings be more reflective of actual costs and that attention be directed toward seed distribution, on-farm seed trees and sowing. In addition, there should be attention given to small seedling depots from which planting stock can be distributed on short notice as rains and work-loads permit.

The number of seedlings produced at the centers is estimated by the project coordinator, Mr. David Muturi, to be ca. 1.5 million. Because of unusually poor rains in the last planting season, however, not all of these were distributed. Of those distributed about 70 percent have gone to farmers who own less than 20 acres of land. Institutions, mostly schools, have taken 10 percent, and larger farmers the rest. Thus far, the purposes for planting trees have related more to traditional uses than to the energy objective.

Distribution of seedlings is very difficult in Kenya because they must be planted during the rainy season when other farm work is

pressing and because seedlings are usually grown in individual containers, making for heavy and awkward loads. Since bare root planting is not practiced, the most obvious solution appears to be in growing the seedlings on or near the site where they are to be planted. Nevertheless a caveat is in order. Central nurseries generally grow better planting stock than small, scattered nurseries because of better supervision. Furthermore, several of the species now being advocated for agroforestry planting, especially those of the genus Acacia, are more difficult to handle than those with which Kenyan farmers are familiar.

Kenyan farmers have a strong tradition of planting trees which the concept of agroforestry is seeking to rationalize. Their reaction to the availability of multiple-purpose trees at very low prices is positive. The special aspect of the agroforestry centers is that they deal with farmers directly and keep records so as to contact each client later regarding survival and uses of the trees.

The reaction to the agroforestry demonstrations is generally one of cautious interest, but not full commitment to tree planting. The centers are acquiring data on the yields of field crops in the presence of trees. A system of continuous appraisal and comparison is needed to strengthen the agroforestry contention that trees and crops can be compatible and of mutual benefit. Such research needs at least five years to provide well-supported data (discussed in more detail in Part II).

Research at the centers appears to be narrowly based upon technical and economic factors. More emphasis is needed upon the social

aspects of reforestation, such as the role of trees in the traditional farming systems and the potential for developing that role with better technologies. Research also appears to be narrowly based upon field crops without sufficient attention to the known positive effects of trees upon grasses. The omission is all the more surprising in that generally tree crops fit into animal husbandry better than into agriculture.

The current extension approach is providing short courses to farmers and agricultural technical agents, and then taking them to demonstration plots where trees and field crops are interplanted. More than 1,000 farmers and technical assistants of the Ministry of Agriculture have participated in such courses.

A more beneficial approach is for the extensionist to visit the farmer in the resident's home village. This can be very effective, particularly if innovative farmers are identified to provide on-farm demonstrations. The Mission suggests that emphasis be put upon such "outreach" methods, rather than upon developing additional sub-centers.

Thus far the agroforestry centers have given most of their attention to introduce interplanting of field and tree crops in rows on the same piece of land. Because the centers are in the Ministry of Energy and Regional Development, the agroforestry program has retained an identity separate from general agriculture.

An alternative approach is to allow the agroforestry centers to become absorbed into the Ministry of Agriculture and support its



new agroforestry program.<sup>1</sup> The approach is holistic and requires analysis of the entire farm enterprise to identify each activity and the emphasis to be put on each of the eight extension specialties. The objection is that inevitably emphasis would be upon food and fodder trees with firewood receiving less attention. Thus the centers would do less to solve a problem of national interest. The Ministry of Agriculture has no mandate to concern itself with wood, whereas the Ministry of Energy does have such a mandate.

Another approach is to have the centers emphasize their distinctive function. This could be done through better communications between the centers, rotation of personnel, meetings to exchange views on successes and failures, and by training, directing and supporting about sixty agroforestry specialists within the extension staff of the Ministry of Agriculture. A sense of identity and purpose would be fostered thereby that would probably increase their effectiveness.

A third suggestion is that the centers change the designation "agroforestry" to Renewable Energy Centers with a corresponding increase in their range of energy-related activities not now assigned to them. They would also increase the range of government and private cooperating agencies with whom to work. Such agencies are the Women's Bureau in the Ministry of Culture and Social Services and the Home Economics Department of the Ministry of Agriculture. Unfortunately the last two now tend to reach only the relatively wealthy (Ref. 4, p. 35),

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1 The Forest Department's Rural Extension Afforestation Scheme within the Ministry of Environment and Natural Resources also has added agroforestry and sought technical support from the project for its 40 extension foresters.

but the centers could be a means for allowing them to reach the rural poor.

It was logical and necessary during the early phases of the project to give principal support to fuelwood-agroforestry and cookstoves. The administrative problems of getting started demanded this narrow focus. Now that the six agroforestry centers are operating and many of the day-to-day functions can be turned over to the permanent staff, it is feasible to direct more attention to other technologies, and to their extension. Heretofore the lack of transport has been a serious problem. The arrival of motorcycles at the centers will help solve this problem.

Both the Ministry of Energy and Rural Development's Energy Development Plan of May, 1983, and its Draft Forward Development Budget Summary: 1983-84 to 1987-88 include items for energy development other than woodfuel. That given most prominence is bio-gas. At this point the support given is principally to set up on-farm demonstrations.

The survey conducted to find out what the recipients intend to do with the wood that is grown indicates that their first choice is to meet their needs for building materials, and then to sell such wood as they harvest and do not need. Material not suitable for those uses they keep as fuel for themselves, and sell or give the surplus to needy neighbors.

It should be clearly stated and accepted as a fact that of the options to increase Kenya's supply of fuelwood, the project has chosen to emphasize that whose primary purpose is other than increasing

the national supply of wood. Agroforestry's primary purpose is not for producing fuelwood; rather, it is a means to improve the over-all farm enterprise. Agroforestry contains elements of crop productivity, soil conservation, animal husbandry, amenity, nutrition and so on; extra supplies of fuelwood are among them but are not the primary consideration. However, to retain their productivity in the tropics, soils must have protection from rain and must retain their organic levels. Trees and shrubs can do both better than annual crops alone.

For the above reasons the project should now consider further activities more closely related to the over-all supply of energy in Kenya, and to the part which wood can take therein. These include peri-urban and commercial plantations, and more rational management of the natural forests and savannah woodlands.

The Country Strategy's goal of helping the rural poor presents another consideration. Agroforestry is a technique for those who own or have access to land. It does not primarily reach the landless or very small landholders. Therefore by branching out into other techniques, the project can stimulate off-farm employment and contribute to increasing the total supply of fuel, both of which benefit the rural and urban poor.

2.3 Stoves and Charcoal Production. A decision taken early in the project's history directed the attention of this program principally toward the development, demonstration and distribution of a charcoal stove re-designed from the traditional all-metal stove by adding an insulating liner. The liner impedes lateral radiation and directs

the heat upward towards the cooking vessel, thereby doubling efficiency of the stove. Although the decision narrowed the program's scope, the results have been outstandingly successful in that 12,000 such stoves are in use and more are being manufactured and sold by private enterprise at the rate of at least 500 per month. Stove manufacturing has become a self-sustaining industry with tremendous potential for expansion in urban areas throughout the country.

The stove industry still requires some input from the project. Each center has, or will soon have, an artisan trained by the project. He will demonstrate the stoves and train local artisans in how to produce them. Several of the problems which still exist and with which the project should concern itself are the following:

- The scrap metal needed is inexpensive and presents no problem, but the clay or other insulating material such as vermiculite must be of a certain quality and price, and is not always available where and when needed.
- The process of manufacture calls for skills which traditionally have been separate, those of the metal-worker and those of the potter. Bringing them together in one artisan or from two operating units requires a re-organization of production methods.
- The manufacture has thus far been small and dispersed and has thus not yet achieved economies of scale.
- Because of the very active demand and limited supplies, some stoves of inferior quality have appeared in the markets and in use.

- Since clay is more breakable than metal, the improved charcoal stoves require more care in handling and using than the all-metal models.

The cost in labor and materials for the improved charcoal stove appears to be about 45 shillings per unit of medium size. With a retail mark-up, the cost to the buyer should be about 65 shillings although prices up to 90 shillings have been reported. Since an average family of six can recover that amount in a month or so through charcoal saved, the price appears to be a reasonable expenditure even for the urban poor. Nevertheless, because the urban poor cannot afford even money-saving expenditures, the Mission suggests that the program experiment with a limited scheme whereby the urban poor can exchange their used and inefficient all-metal stoves for an improved model. The project will absorb the difference in value but salvage the usable metal.

The technical performance of the improved charcoal stoves has been very satisfactory in that they require 50 percent less fuel to cook the same amount of food.

The short time in which the improved stoves have been in use precludes a widely-based verdict on their durability. The factors which might influence such durability are materials, artisan skill, handling and conditions of use. Properly made, used and cared for, they should last 18 to 24 months.

The projected annual demand by the year 2000 is 1.7 million (Ref. 28). Thus, daily production of 7000 units should bring about

economies of scale, reduction of price and better control over quality. A problem to which the program has not yet given sufficient attention is that of distribution. Thus far it has only had to demonstrate them at training courses and at agricultural fairs to create a demand far outstripping supplies. As a result several entrepreneurs have set up businesses to make and sell them. To conclude therefore that word-of-mouth publicity is sufficient to make them well-known may be oversimplifying. In fact, the urban poor who need the stoves most may not know of them, or may not have access to markets and money to buy them. Whereas the use of charcoal is principally an urban phenomenon, the project's centers are in high potential agricultural areas where charcoal production and use are relatively unimportant. This fact impedes distribution where most needed.

Far too few data are available regarding the making and marketing of charcoal. Nevertheless, it appears that a significant and probably increasing proportion comes from the thinly-populated semi-arid wooded savannahs of eastern and coastal Kenya. From that point of view the Wambugu, Kisii and Bukura centers are not well placed to deal with charcoal. Most progress in its use has occurred at Ngong and Mtwapa, near Nairobi and Mombasa respectively, where well over half of all charcoal in the country is used.

The Mission therefore suggests that in addition to giving attention to the other problems listed, the program contact organizations, both public and private, dealing with the urban poor and inform them of the improved stoves. That information will of itself stimulate

demand but not necessarily supply unless the exchange program noted or similar schemes can be made to work.

Furthermore, the Mission suggests caution in the increased use of charcoal. Charcoal does represent a notable advance over wood in household convenience and health. Whereas the coaling of wood loses energy, it saves energy in transport and in the work of gathering, cutting, splitting, carrying, storing and using domestic firewood. Even with Kenya's wood-growing stock just under one billion tons and with an annual yield of nearly 50 million tons, species substitution, silviculture, and afforestation will have to increase enormously to meet the projected more than doubling of demand by the year 2000 (Ref. 41).

The program has not yet given attention to charcoal production methods because of a decision to concentrate efforts on improving charcoal stoves. Now that the stove aspect has made much progress, several recommendations regarding charcoal, during the remainder of the project period and thereafter, are the following:

- A detailed study of where and how charcoal is produced, its transport, marketing and pricing, and particularly its place in the local economy, relation to cattle ranching and wildlife, and effect upon the local ecology.
- A comparative study of charcoal-makers' methods to identify those which give higher yields with the traditional kilns.
- The use of the most skillful artisans to discover the best methods and transmit them to other artisans.
- The testing and use of metal and brick kilns on Forest De-

partment sales in the gazetted forests.

- The encouragement, through the Energy Development Fund and other means, to establish commercial plantations to grow wood and manufacture charcoal.

- Encouragement to the Forest Department to give more attention to producing charcoal wood on gazetted forests by modifying management and pricing policies. The gazetted forests are said to have 400,000 hectares of treeless land. (Ref. 27) Furthermore, forests now held without cutting for their water yield can produce more water flow with less standing volume. Such modification should be done only with great care for its effects on wildlife and ecology.

- Adjustment of national policies regarding permits, legal species, stumpage prices, production and transport taxes, price controls and export to the social objective of abundant, reliable and low-cost energy supplies.

- Research on how to combine animal husbandry and forestry on Kenya's more than 20 million hectares of savannah woodland (Ref. 41). In these areas, fodder trees are effective in supplying protein for animals.

Thus far the program has given attention to charcoal stoves and done so successfully. The program's plan of work now includes research on and demonstration of two prototype portable wood-burning stoves. As with the prototype of the improved charcoal stove, technical services and financial assistance will be needed to initiate production capability to meet a projected demand of over 2.5 million



improved wood stoves by the year 2000 (Ref. 28).

The efficient use of firewood is far more complicated than that of charcoal. Three uses are entailed; they are, (1) cooking, (2) radiating heat, and (3) radiating light. Delivering heat to a cooking vessel can be increased easily if that is the only concern. Even price is not insurmountable.

But a stove that is delivering more heat to a pot is not radiating heat and light for domestic use. The last two functions are not pertinent to daytime when much cooking takes place. A suggestion is therefore to separate cooking from radiating heat and light as is done in most western households. Having two sources of heat need not be wasteful with different purposes and times for use. The German-financed Maendeleo Ya Wanawake program of Nyanza Province is applying this principle successfully.

Among the activities suggested for the wood-burning part of the program during the remainder of the project period and thereafter are the following:

- Investigate the possibilities of a two-stove cooking system.
- Investigate how food preparation and diet can be improved so as to be compatible with less fuel.
- Investigate the design, use and distribution of wood-cutting tools suitable for large as well as small trees and branches.
- Promote the design, manufacture and distribution of wood-cutting tools that are less dangerous, wasteful and laborious to use than present tools.
- Encourage the use of external outlets (based on the principle

of a chimney) in rural houses for smoke.

- Encourage the establishment of woodyards where green wood can be sold and dry wood bought.
- Devise planting programs with regard for those who must collect the wood (i.e., women). Trees used near the point of growth save in transport costs and receive more protection.
- Encourage public authorities to use and replace overmature trees in urban parks and gardens, along streets and roads and in vacant lots. Such trees are dangerous and wasteful of resources.

A survey of the users of improved charcoal stoves has shown that they spend less time cooking and use less charcoal than prior to the improved stoves. The positive effects upon household budgets, health and general welfare are significant.

2.4 Conservation. Positive evidence exists that the project studies and recommendations are having a significant influence on GOK policy formulation. When adopted, however, implementation of policy requires budgetary allocations and structural changes which are difficult to bring about because of fiscal limitations and governmental procedures. For example, the Interministerial Committee on Energy Conservation in October 1982 (Ref. 42) adopted eight policies and actions suggested by the project. Among these, Recommendation No. 4 suggested that the Ministry of Commerce and Industry establish a program to identify and evaluate energy sector investment opportunities. Such a program required certain studies and additional staff that were not provided.

Similarly, Recommendation No. 5 to re-schedule school bus services required a coordination with the private sector and other government ministries which proved impossible because of lack of MOE staff.

In the case of Recommendation No. 3, the implementation was possible because of project funding and support. This Recommendation suggests that MOE develop a program of energy audits and provide technical assistance and training.

The MOE is now requesting the project to emphasize fuel substitution rather than conservation. A coal substitution study is underway which will have significant results if the conclusions are incorporated into the ongoing World Bank project planning for energy.

The Mission also recommends that the project examine other fuel substitution opportunities, such as the use of agricultural and wood by-products; for example, sawdust (of which an estimated 80,000 tons are available each year), coffee husks and pineapple waste for specific industries.

Taking such circumstances into account, the project's conservation program has concentrated upon private industry. The project has coordinated training activities with an audit and technical assistance program. Of the three training courses given, one included firms specifically selected for auditing so that almost every firm attending this course carried out some or all of the audit recommendations. For example, Steel Rolling Mills, a private firm, has undertaken conservation improvements at the project's suggestion. The firm has saved 25 percent of its energy consumption, estimated at 810,000 Kshillings per

year. When all suggested changes are made, the firm should be able to reduce its energy costs by 60 percent. Since energy accounts for 25 percent of all inputs other than the unprocessed material, this reduction will significantly improve the company's price competitiveness. Of the improvements, most entailed maintenance or operational practices with equipment or additional structures manufactured by the firm itself. Only two items requiring foreign exchange were needed to make improvements.

The project has trained 35 employees of the Ministry of Energy and another 13 industrial engineers through the Kenya Polytechnic. This training has stimulated action on the part of several firms and institutions. For example, the Aga Khan Hospital is spending one million Kshillings on conservation equipment as a result of instruction given by the project and has accepted a number of conservation recommendations.

The project also took advantage of training offered by the Tennessee Valley Authority through AID/W/S&T/EY. Five firms were selected to participate in this training program, and paid all travel expenses for their attending staff, with the exception that the project funded the Kenya Polytechnic participant. Several of the trainees have since written to the project describing the changes that have been made in their respective facilities based on the training.

The project emphasizes that training or auditing in isolation is not as effective as a coordinated program of training, audits, and technical assistance. Several instances exist where audited institutions,

most often after project training, have carried out improvements in the operation of existing plant equipment or have installed new equipment and structures, and have realized significant savings.

In proposing a budget revision as recommended by the Evaluation Mission, the project staff should indicate allocations to supplement the conservation program, particularly for training and audits, and should include cost-benefit analyses.

Evidence of letters and interviews with recipients shows that these activities have been extremely useful. For example, Mr. J.O. Omboto of the Panafrican Paper Mills acknowledged the usefulness of his attendance at the energy conservation course in the United States:

"I have prepared and handed to my company management an energy conservation report for half of our factory which should save the company about Ksh.7,000,000 per year if implemented" (Ref. 35).

The missing element in the expansion of the program's activities is a mechanism to carry out feasibility studies and energy audits of improvements so as to assist firms in obtaining loans. Such a mechanism would promote increased interest in training and audits. It meets a need for worthy projects on the part of regional development banks.

The Mission recommends that an effort be made to improve the Polytechnic's capacity for giving conservation courses to support the demand generated by the feasibility studies. The provision of equipment and curricula would be useful; it might also be possible to provide the Polytechnic with a grant through the EDF. In addition, the project should develop the private sector institutional capacity to

carry out energy audits and feasibility studies. The EDF is an appropriate vehicle to encourage this institutional development, through provision of funds for audits and prefeasibility studies.

2.5 GOK Coordination. Before the start of the project, the Ministry of Energy (now the Ministry of Energy and Regional Development) was giving only minor attention to energy fuel conservation and the wood resource. According to Project Coordinator David Muturi, as of March, 1983, the Government's contribution to the project had been as follows:

Land Development	Ksh. 5,671,750
Center Establishment	5,092,000
Personnel	1,270,000
Conservation Planning	<u>210,000</u>
Total	Ksh. 12,243,750

According to the same source, the Ministry anticipates that its additional contribution to September 30, 1984 (PACD) will be as follows:

Land Development	Ksh. 1,781,000
Center Support	3,485,000
Headquarters Staff	1,420,000
Conservation Planning	<u>440,000</u>
Total	Ksh. 7,126,000

During the three-year operational life of the project, the Government's anticipated contribution will be 19.4M Ksh. (970,000 pounds), about \$1.4 million as compared to the Project Paper estimate of \$1.7 million. For FY 1983/84, the Government's contribution is

14,300 Kenyan pounds (Ref. 40). For the next four fiscal years, the projected contributions to woodfuel and other renewable energy technologies are as follow (excluding solar, wind, nuclear and tidal energies):

Year	1984/85	1985/86	1986/87	1987/88
Pounds	18,201	30,799	34,199	49,099

Source: Ministry of Finance and Planning Budgetary Projections  
FY 1984/85 - FY 1987-88.

These figures are considerably less than those which appear in the Ministry of Energy and Regional Development's Development Budget for the years 1984/85 - 1987/88. The above figures are minimum commitments only. Nevertheless they cannot carry all the activities suggested herein. The Mission suggests that as far as possible dependence be placed upon private enterprise and organizations, and that, through a system of monitoring and evaluation, the Ministry concentrate on those activities yielding the highest returns.

The Planning and Development Division of the Ministry is preparing a Draft Energy Policy Document (Ref. 38). The Minister appointed the document committee in mid-1982 in whose deliberations the project staff has participated. They supplied much of the energy conservation and agroforestry elements appearing therein. The document recognizes the energy/agroforestry centers and the need to continue their operation, a point of view reflected in the 1984-1988 Five Year Plan. A further recognition appears in the Energy Development Plan 1983-1988 Part I of May 1983 (Ref. 39).

Thus the overall effect of the project on Government policies

can be summed up as a recognition of the importance of wood as a source of energy, and the importance of energy conservation. Furthermore, several of the Government's official pronouncements have urged the public to plant seedlings and grow more wood. The national goal is now to plant 200,000,000 trees a year, about double the present rate, even though 50,000,000 is a more sensible through politically impossible goal. Numbers of seedlings are not a problem. In fact there is probably an over-supply. But quality, distribution and survival are problems, as well as finding land of satisfactory quality without impinging upon agriculture.

Several recommendations for appropriate programs during the remaining life of the project and thereafter are as follows:

- Establish the library and energy data bank within the Ministry of Energy and Regional Development as provided for in the Project Paper (II. Project Description D1) and the Project Agreement (Annex IB).
- Further strengthen and expand the links between the ministerial headquarters and the centers.
- Expand center activities to include wood-burning stoves, charcoal kilns, home economics, site-specific renewable energy, more diversified sources of seed and seedlings, energy conservation in schools, hospitals, public institutions and commercial enterprises, and far more attention to the extension of techniques which have proved their worth. Such expansions should take place in consultation with the Center Advisory Committees.
- Using the designation, "Renewable Energy Center," implies more



than just agroforestry. Thereby they can become centers of innovation closely linked to the energy problems of the local population.

- Expand present working relations with other agencies, public and private, which have or can have a significant role in solving the energy problem. These agencies include the Women's Bureau of the Ministry of Culture and Social Services, the Wood-fuel Development Project of the Beijer Institute, CARE-Kenya, KENGO, the Kenga Agricultural Research Institute, Mazingara Institute, International Development Research Center, and the Presidential Committee on Soil and Water Conservation.

- Give attention to options for increasing woodfuel other than agroforestry such as commercial plantations, peri-urban plantations, more emphasis on energy in the management of the gazetted forests, and attention to the 20,070,000 hectares of savannah woodland which have a volume of 508,490,000 tons of wood and an annual yield of around 30 million tons (Ref. 41). A plan is underway to start a peri-urban plantation for fuel of 2000 hectares in the Ngong Hills Catchment Area for which the Ngong Center has offered to supply the planting stock.

The project is administratively in the Ministry of Energy and Regional Development, but operationally within the Ministry of Agriculture. The centers are located on the grounds of the Ministry of Agriculture and depend heavily upon the Farmers' Training Centers for support. A Memorandum of Understanding dated February, 1982, covers the working relations between the Ministries of Energy and

Regional Development, of Agriculture, and of Environment and Natural Resources. The project has, in its operations, included the International Center for Research in Agroforestry, the University of Nairobi, and non-governmental organizations concerned with energy through joint training programs, exchange of teachers and lectures.

The Inter-Ministerial Committee on Energy was influential in initiating the project but is no longer active. The project staff believes that cooperation can also be arranged informally in dealing with specific situations and issues. One meeting of the Donors' Committee was held in February 1982 but further meetings were not held and have not been planned. The Draft Energy Policy Document (Ref. 38) included a plan for a National Woodfuel Energy Board.

Kenya has at least 35 agencies involved in reforestation, and many more involved in other aspects relevant to the project. For example, the German Special Energy Program is working on site-specific technologies such as solar, wind and bio-gas. It is practical to deal with them in small groups as well as through the Donor's Committee specified in the project agreement. Probably the most serious omission has been the failure to establish closer relations with the Women's Bureau of the Ministry of Culture and Social Services.

The contract between the Government of Kenya and Energy Development/International, Inc., has provided a full-time staff of four at headquarters. They are an agroforester/team leader, an energy conservation engineer, a forester and a stove specialist. The contract with the last is about to terminate. Working as counterparts with them at headquarters are four ministry employees.

The contract has hired for the project under procedures and with salaries of the Government eleven personnel to staff the centers, seven of them recent university graduates. The Ministry itself has supplied a center manager for Wambugu. The Ministry has hired six stove-workers with the status of day laborers and is expecting to hire a staff librarian soon. The six centers have 270 casual laborers. Thus far, the Ministry has transferred seven professional personnel to the project and has hired two new ones.

To operate successfully at the projected level, the project needs at least 50 professional personnel, eight for headquarters and seven assigned to each of the six centers. The entire number at present is 32, of which eight are Peace Corps Volunteers, nine are Ministry employees, four are on the EDI contract and eleven are hired by EDI. The crucial problem for the project's future is the rate and extent to which the Government of Kenya, through the Public Service Commission, absorbs the eleven local contract employees and provides the eighteen more needed to replace the Peace Corps Volunteers and fill out the complement needed to allow the Ministry to carry on the project and keep the centers alive and innovative. The Ministry has agreed to the proposed number in a memorandum of October 12, 1983, to the contractor.

Very serious problems exist regarding the rate at which the Government can establish new positions, fund them and recruit suitable personnel. For one thing, the positions are new and do not correspond to established GOK job description categories. For another the Government is already top-heavy with civil servants, each one of whom

acquires rights that become permanent obligations. The process is necessarily slow and justifies some extension of the project period.

Nevertheless, the project must operate within time constraints where flexibility is limited. The Mission suggests that the project establish a schedule for withdrawing support to EDI-hired personnel in such a way as to mesh with a Ministry schedule for hiring them or replacements. The project must stay with its schedule because of budget ceilings. If the Ministry does not stay with its schedule, the conclusion must be that the Government finds other matters more pressing.

If the Government decides not to continue the centers under the present Ministry, they probably could be incorporated under the Ministry of Agriculture. In that case the concern and drive which started them may be lost, and the present Ministry's energy effort would be handled out of the headquarters without a field presence.

The budgetary plan quoted above is an indication of the Government's commitment at this time regarding project activities. After the termination of AID project support, the Government will probably expand the budget through other donor support. For example, the Dutch Government is funding an agroforestry project in the Western Province through the Beijer Institute which has drawn upon REDP experience. DANIDA is initiating a 10,000 hectare reforestation scheme in the Taita Hills of the Coastal Province and an agroforestry program likewise. Such developments are consonant with the goals and purposes of REDP. Nevertheless if fiscal problems require the work of

the Centers to be curtailed, the Mission suggests that they cut back seedling production and favor seed orchards and farmers' training.

2.6 Energy Development Fund. The Project Paper discusses this type of assistance as being directed toward energy demonstration and extension programs. The Project Agreement enlarges its purposes to include the development of technologies. Evidently it was looked upon as the project's motive force in extending proven technologies for increasing the production and efficient use of Kenya's renewable resources. Both the Project Paper's financial planning and the project budget as amended by Project Implementation letters 12 and 19 provide \$644,000 as Item (6).

The comprehensive pipeline report of 10/12/83 lists this item as Element No. 4 with the addition of \$3,000 for participant training. Of the \$644,000 specified as committed, \$13,812 had been disbursed through an advance payment made by USAID by April 21, 1983. On the other hand, the Project Agreements' Timeline Project Activity schedule of Annex II (III-B Energy Development Fund) indicates that the first year grants award was to have taken place by October, 1981. The fund's operations thus became delayed by 18 months. Furthermore, because accounting for advance payments is required within 90 days and because accounting for the advance of April 21, 1983, has not been received by AID, the operation of the fund is at a standstill for that reason alone. Discussions with officials of the Ministry of Energy and Rural Development have not brought out clearly the reasons why this part of the project has been so ineffective. Perhaps the following observations are in order. First, the officials of the Ministry do not

have a tradition or experience in handling grants. The delays in processing proposals are owing to this fact as much as to the procedures and criteria. Also, the Ministry did not appoint a governing board for the fund and did not clearly designate a responsible official to manage the fund.

Second, the criteria for making grants are complicated and time-consuming. Furthermore, the Ministry has not established clear procedures for disbursement and accounting. The Project Paper's directives include the establishment and approval of criteria, the involvement of District Commissions, financial and technical reviews and approvals by the Ministry and AID, district quotas, and ceilings on grants and loans in different categories.

Third, it is difficult to establish standards for passing on the soundness of proposals for demonstration. The proposals must be economically sound to be accepted, and yet most of the activities listed in the Project Paper as suitable for the Energy Development Fund have yet to prove their economic viability.

Finally, the project staff which was to have given technical assistance has given attention to other activities as a result of a joint decision by MOE and AID to delay action on the EDF to January, 1983.

The Mission is of the opinion that either the funds earmarked to the Energy Development Fund should be de-obligated, or action should be taken along with following lines:

- The permanent Secretary of the Ministry of Energy and Regional Development should be invited to designate an official at least

at the Deputy Secretary level to be responsible for handling this fund and getting results.

- The fund manager should inform lending agencies whether public or private, and entrepreneurs that it will finance 75 percent of feasibility studies of energy-related proposals up to \$20,000 to produce bankable projects.
- If the feasibility study shows an economically sound enterprise, the fund can grant up to 25 percent of the start-up costs and engineering demonstrations up to a maximum of \$25,000. Where appropriate, use will be made of financial institutions such as the Industrial Development Bank.

The rationale for the above suggestions is as follows:

- to realize several specific results out of what was to be the motive force of the project;
- to raise the interest of lending agencies in energy-related proposals;
- to involve the private sector in the efficient production and use of energy; and,
- to improve the capability of the Ministry of Energy and Regional Development and its confidence in the use of such a fund to promote the purposes of the project.

The funds will operate through grants payable on vouchers certifying work done or equipment bought for commercial enterprises in place and working. The fund will also offer to help non-government private organizations on a grant basis for up to 25 percent of the cost to prepare proposals for energy-related activities reimbursable

under the fund's criteria. The purpose is to establish a conduit to small groups and individuals with capabilities for energy production and uses. It will also make contracts with NGO's to carry out projects in keeping with the purposes of the fund. The advantage of contracts over grants is that the EDF can take the initiative.

The fund will make grants to other government agencies as experience is acquired and as opportunities expand.

2.7 Personnel and Management. The most important budgetary change was that which has raised the Beijer Project Support and Energy Systems Contract from the \$150,000 appearing in Table IV-1 of the Detailed Cost Estimates to \$249,150 in the Comprehensive Pipeline Report. Of this amount, \$75,000 came from the technical assistance and \$74,623 from Item 5 for Inflation. The second was that which added an item for purchasing a minicomputer of \$100,000, also taken from the technical assistance contract. The third was the Energy Systems Research Group Contract of \$188,508 (making a total of \$537,658) also taken from the inflation item of the Project Agreement's Illustrative Budget.

These changes have thus far had no effect upon those operational aspects of the project which concern agroforestry, fuel conservation and stoves/kilns. The reason is that the aspects which received higher allocations have not yet provided significant results to the project operations.

Another significant change was the addition of \$96,000 to the commodities budget for purchasing mobile equipment. The equipment is on order but has not yet arrived. The change came about because



experience at the agroforestry centers suggested the need for more mobility than anticipated in the Project Paper.

On April 20, 1983, the contractor, Energy Development/International, Inc., proposed changes that would add \$444,139 to its budget. The principal purpose was to facilitate contracting, hiring and procurement because of the complicated and slow procedures required by the Government. The Mission believes that the changes proposed are necessary to keep the project operative. The principal reservation is in regard to the hiring of personnel. Thus far, the Ministry's record has not been satisfactory in that of the approximately 50 positions needed to man the headquarters' and centers' staffs, the Government has added only two employees, whereas the EDI contract has hired eleven.

The Mission therefore suggests that the Ministry draw up a schedule of transfers and hiring that will fill as many of the 50 positions with corresponding operating funds as budgetary limitations allow, and staff the centers progressively over the remaining period of the project, and that the present EDI employees be dropped according to that schedule, whether the Ministry takes them on or not. This suggestion appears practical in that the Ministry has vacancies and extra employees who could be transferred to project activities.

If a no-cost extension of the project carries it to the start of the fiscal year 1985-1986 (July 1, 1985), provision will have to be made for extending the EDI staff or hiring consultants as they are needed to take the place of those that have left. The transfers of funds out of technical assistance to the LEAP program have made such

extension impossible under the present and proposed budgets. A full extension of the EDI contract for nine months requires \$450,000.

The Mission suggests that the project staff and counterparts prepare a plan of work and expenditures to include the period from September 30, 1984 (PACD) to July 1, 1985 (start of the GOK fiscal year) in using uncommitted balances for such technical assistance as they see as most appropriate, providing for the withdrawal of the project staff as budget limitations require and as the counterpart agency progressively takes over project activities and responsibilities.

The revised plan for the conservation and fuel substitution program includes the Ministry's request for the coal study which appears as Item 4 of the Statement of Work (Section 5) of the AID-financed Beijer-Clark contract. Clark did not carry out that study as provided in the contract. A further change in the revised plan puts added emphasis on public information in accordance with project staff's judgement after discussing the change with industry and government officials. The revised plan reduces support for economic studies and transport and for gathering residential data because the Ministry of Transport has gathered that data. The change has made it possible to focus more on public information and preparation of material for training.

The stove and charcoal program revised its plan of work to put emphasis upon improved charcoal stoves, thus delaying those aspects which concern wood-burning stoves and charcoal kilns. The choice of emphasis appears well taken and has given excellent results in that 12,000 improved stoves have been made and sold.

The program's stove specialist is about to leave the project because his contract is about to terminate. If his contract is renewed as EDI has proposed, he will revise the work plan again to give less emphasis upon charcoal stoves and increased emphasis upon wood-burning stoves and charcoal kilns. If he is not available for another 18-month contract, he could presumably be hired for shorter terms. Some suggestions for emphasis are the following:

- The present charcoal kilns probably vary as much as 15 percent in their yields depending on the skill of the operator. Instead of trying to introduce small metal or brick kilns to improve yields among small producers, it is suggested that exceptionally skillful charcoal artisans be located, their methods studied and an effort be made to have them transmit those skills to other charcoal makers.
- The Forest Department contracts for the making of charcoal from logging slash on gazetted forests. It could attempt to rationalize those operations by the use of metal or brick kilns under its supervision.
- Through the Energy Development Fund, encouragement could be given to commercial plantings to produce charcoal. The area most appropriate is the Coastal Province where lands with rapid growth rates for trees are available, the railroad is present for cheap transport upcountry and, perhaps most significantly, there is a potential to increase Kenya's foreign exchange earnings through access to the Middle East market. However, it is unlikely that private enterprise will undertake commercial plantings unless the controls on charcoal

prices and export are removed.

- Apparently very little is known about the production and marketing of charcoal, about its social and employment implications, and about the effects of producing charcoal upon the ecology of the areas whence charcoal comes. Much of the deforestation blamed upon charcoal may in fact be due to over-grazing and itinerant (swidden) cultivation. It should also be pointed out that charcoal use represents greater convenience for the housewife over wood, which is bulky and smoky, and whose burning requires more attention. Furthermore, the economics of charcoal need a careful study to convince the Government that controlled prices are certain to produce shortages of charcoal and thus add to the burdens of the urban poor. The official price of 50 shillings for an 85-kilo. bag has no evident relation to costs.

The problem of improving the use of wood for fuel is very much more difficult than that of improving the use of charcoal. A more efficient wood-burning stove has yet to appear acceptable on a significant scale. The Mission suggests that the search for an acceptable prototype be continued, and that trials be made of better stoves in schools, hospitals and wood-using enterprises.

Nevertheless, the time has come to explore other approaches whose objectives are partly to improve wood's efficiency in the kitchen, but principally to ease the burden of domestic work and improve nutrition. They include small modifications of the three-stone fireplace with grates and windbreaks, improved cooking vessels and methods, soaking and grinding grains to reduce cooking time, better control of temperatures and

timing. Kenya has appropriate organizations for training and dissemination of such information. A six-month consultancy of a home economist has been proposed to study this aspect of the program.

The agroforestry component of the project has a revised plan of work dated December, 1983. The plan outlines an expanded program along the lines suggested in this evaluation report. Financial requirements are not included.

The LEAP model program does not yet have a revised plan of work.

Without changing the objectives of the project, there are at least two significant changes which have come about through experience gained in project operations. First, there has been a shift away from site-specific energy techniques such as wind, solar, hydro, and bio-gas power. This change came about partly because the Ministry wished to emphasize agroforestry. It was further perceived that site-specific renewable energy is too expensive for general use in rural Kenya and is therefore inconsistent with the project's objective of helping principally the urban and rural poor.

As a consequence, the renewable-energy engineer provided for in the project was not hired, and the savings were used for support to the agroforestry centers. These centers are appropriate for bio-gas development and demonstration because bio-gas is strictly an on-farm product, and the centers deal principally with farmers. On the other hand, the concept of bio-gas generation as a practical technique for owners of small farms is probably not realistic. It can work occasionally as a show-piece, but is a long way from having a measurable effect upon the overall energy situation.

Second, the operation of the project has revealed that whereas the Government has responded with policy and budgetary changes, it has been less effective in implementation. The institutional difficulties block rapid and effective action except in such matters as policy, incentives and pricing. Unfortunately, its pricing policies regarding charcoal stem more from political than economic motives. As a result of these difficulties, the project has moved toward private enterprise in the conservation program and toward non-government organizations in the agroforestry program. These changes are consistent with the specific purpose of the project stated in Item C of the Project Description, which stresses the capability of the Ministry to formulate policy, to plan, oversee, monitor and evaluate, but does not mention the capability to implement.

### 3.0 Analysis of Project Strategy

This project came about principally from a concern over the increasing cost and quantities of petroleum imports. The Project Paper (Ref. 10, P. II-2) pointed out that wood-based fuels accounted for 80-90 percent of the needs of Kenya's population for domestic fuel. A logical inference was that along with more careful use of petroleum, there could be a reduction in its import if the wood resource could be expanded and used more efficiently. Other studies (Ref. 22) pointed out that over-cutting and lack of replacement were undermining the forest resource upon which reliance was placed for restraining imports of petroleum. Hence arose the perception that a renewable energy project would have to

include attention both to the forest resource and to other site-specific resources such as wind, solar, water and bio-gas as well as to petroleum and coal.

Thus the project has sought from its inception to bring together in one coordinated endeavor such diverse elements as high technology computer analysis and the best way to cook maize meal. The Government had designated the Ministry of Energy for such coordination and it became the project's counterpart agency. The Government's mandate for this Ministry includes woodfuels (Ref. 19, p. 6) and for this reason its designation as the host institution by the Inter-Ministerial Committee on Energy meeting on 6/3/80 was well made. The Ministry has since been expanded and renamed the Ministry of Energy and Regional Development. This change has given it field implementation responsibilities which should increase its capability to identify local renewable energy problems as well as those at the national level. To date, coordination with other ministries has been satisfactory and will be expanded.

Each element of the project could logically be placed in some other ministry; planning in the Ministry of Finance and Planning; fuel conservation in the Ministry of Commerce and Industry; charcoal stoves in the Ministry of Culture and Social Services; reforestation in the Ministry of Environment and Natural Resources; and so on. It has even been suggested that various aspects of the project be so placed. The Evaluation Mission is against such proposals. The project would thereby lose its coherence and drive; and it would not respond to the energy crisis which the Kenyan Government perceived as urgent enough to warrant a separate ministry. The Mission believes that that ministry can best

retain the project's drive and identity while operating through a variety of agencies both public and private.

Because other points of view must be taken into account, the project has a broad base for such cooperative action. For example, one of the project's principal instruments to "make progress in achieving a balance in wood fuel supply and demands" is the technique of agroforestry. That technique's purpose is not specifically to increase wood supply; rather, it is to use trees for the overall improvement of the farm enterprise. Nevertheless, MOE is participating in that improvement to a further extent than if agroforestry were a minor part of MOA or MENR.

Another source of tension has come about through the contract which the Government of Kenya employed to help implement the project's programs of industrial fuel conservation, wood-use conservation and agroforestry. The Government's procedures for recruitment, disbursement of funds, procurement and other operations have proved to be too narrow and cumbersome for a four-year project moving into new activities. For example, the project's ten vehicles are in a ministry motor-pool and not available for late or week-end work. Consequently, so as to speed up the project, the contractor has moved into those activities. Thus it has hired and now has on its payroll eleven employees because government procedures were too slow to maintain project operations. Such recruitment was necessary; and yet it has created the problem of how to absorb those employees into the Ministry, so that the project activities can continue after the termination date.



#### 4.0 Barriers and Constraints

4.1 Coordination. Because of the project's multiple modes of operation and the consequent need to enlist the support of ministries and agencies other than the counterpart Ministry of Energy and Regional Development, Section 5.5 of the Project Grant Agreement provides for the continued existence of an energy-coordination body. An Inter-ministerial Committee on Energy did exist and did focus attention on the energy problem. Apparently it is no longer operative. Moreover, the periodic reviews and examinations of this project have not taken place as Section 5.5 provided.

The Mission believes that Section 5.5 should not lapse. Even though lack of inter-agency coordination has not been an important constraint upon the project's operation, the lack of periodic reviews and examination of progress has been a constraint. Two circumstances make Section 5.5 important at this time. First, the project is ready to expand its activities and will require new contacts with agencies which have hitherto not participated in the project and which the coordinating body can identify. Second, the project should soon move into a final phase wherein the Ministry will progressively take over operating responsibilities and personnel.

Section 5.2 provides for donor coordination through quarterly letters and the convening of an annual meeting of external donors. The Ministry has not complied with this Section. Again it should not lapse unless the project agreement so specifies. Failure to fulfill the obligations of Sections 5.2 and 5.5 has been a constraint upon project operations.

4.2 Survey and Planning. This part of the project received \$150,000 in the illustrative budget and \$387,658 more as a result of budgetary changes. It does not appear among the four items which define the project in Article 2. The Project Paper provides for support to the Beijer Institute Fuelwood Cycle Planning Project through the installation of an "AL-EDIS" energy assessment system, later replaced by the "LEAP" system. Nevertheless, the Project Paper does not make clear the link between that service and the purposes of the project as stated in Section IB of the Summary and Recommendations.

This part of the project has not produced results to advance those purposes. It will probably do so only after considerably more training of personnel, after a strong system has been established to collect and organize basic data and after it has been coordinated with the economic models installed in the Ministry of Finance and Planning.

The fact that this aspect of the project has been in a division (Planning and Development) different from that of agroforestry and cookstoves (Biomass Division) has left a breach between them. The Project Advisory Committee has not been effective in coordinating them.

The Mission believes that responsibilities for this project in the Ministry should be at the level of a Deputy Secretary to whom both the project coordinator and the EDI contract team leader have access. Heretofore the responsibility has been placed in separate divisions and thus at too low a level to achieve administrative efficiency. Now is a strategic time to suggest that change because the Ministry is undergoing a reorganization.

4.3 Project Assistance Completion Date. In view of the decision to follow Government regulations regarding procurement and recruitment, the completion date has proved unrealistic. Many of the commodities have not yet arrived and eighteen of the personnel needed to carry on project activities are not yet in place. The fact that the EDI contract has had to buy materials and hire temporary personnel has caused confusion and distracted staff attention from technical aspects.

The single most serious barrier to achieving the PACD has been the delay caused by the Beijer/Clark Contract. As pointed out previously, that contract was to have provided budgets, workplans and selection of the agroforestry centers. The fact that it did not do so was a serious hindrance to the progress of the project.

4.4 Agroforestry. Except for the delay involved, it is probably just as well that the project staff choose the sites of the agroforestry centers rather than an outside organization. The choice was made to concentrate on the high potential, densely populated western (two centers), central (two centers) and coastal (one center and one sub-center) areas of Kenya. The sixth center is in a semi-arid, thinly populated region of the Eastern Province. A decisive factor was the need to locate them where facilities were in place or could be developed, where land was available, and where links with training institutions could be established. They are well placed for the purposes of agroforestry and are each near enough to an urban area to have some significance for charcoal. The only question the Mission has is regarding the similarity of Kisii and Bukura. Perhaps one of the two should have been in the low-lying area near Lake Victoria (also discussed in Part II). Kitui has the possibility

of expanding its activities to include silvopastoral management. On the other hand they are not quite consistent with the Project Paper's stated purpose of placing them in Kenya's major ecological centers (sic). (Ref. I Project Paper p. I-3).

The emphasis placed upon agroforestry and multipurpose trees has been respected. However, that emphasis has brought about a conflict of aims that has created some confusion. Neither agroforestry nor multiple-purpose tree crops are primarily concerned with producing renewable energy. Their purpose is to improve the total farm enterprise, a laudable purpose and one consistent with AID's Country Strategy but not entirely with the project goals of reducing imports of fossil fuels and achieving a better balance of wood fuel supply and demand. Thus if an alarming crisis is imminent regarding wood supplies, depletion and forest devastation as the Beijer Draft Report states so categorically, that fact is not reflected in the project's choice of sites and emphasis. For that reason the Mission suggests that the project henceforward give attention to options to produce energy other than agroforestry and multiple-purpose trees alone.

Another characteristic of this project that has limited its effectiveness is its almost total disregard for the fact that in Kenya, as elsewhere in Africa, fuel for light, heat and cooking is a woman's business. Instead of starting from concerns about balance of payments and forest devastation, a renewable energy project might better have started with an analysis of the woman's problem of the scarcity, cost and convenience of fuel. Significantly, the project has as yet no memorandum of understanding with the Ministry of Culture and Social

Services which handles women's affairs. It has not yet employed a home economist to study how more efficient use of fuel can be brought about in the kitchen and it has not organized the agroforestry centers' advisory councils in such a way as to be aware of the woman's point of view.

If the project had chosen to concentrate upon large-scale plantations, the omission would have been of less import. But having chosen to concentrate upon the densely populated high-potential areas where women carry on intensive small-scale farming, the omission may be a serious barrier to the project's further effectiveness. For example, if women and children are already overloaded with work, is the project realistic in expecting them to undertake another task? They may plant trees from a sense of patriotic duty and then neglect them from sheer weariness. If they are short of cash rather than fuel, which may well be the case, is the project correct in emphasizing farm sufficiency in fuel rather than wood sales? For such reasons the Mission suggests that the project make adjustments that will bring it nearer to those to whom wood energy is a day-to-day problem. Unfortunately the folklore of planting trees tends to place the burden upon unpaid women and children.

4.5 Energy Development Fund. The Project Paper emphasized the EDF as a device to stimulate demonstration and extension of energy-producing and energy-conserving technologies. Unfortunately, the procedures outlined in the Project Paper have proved to be too cumbersome and complicated. Far from being the motive force of the project, it has been time-consuming and unrewarding. Perhaps the activities envisaged might better be handled through contracts with appropriate

agencies.

The Mission therefore recommends that the EDF's management be put on the Deputy Secretary level and that it concentrate upon financing feasibility studies and grants to commercial energy-related private enterprises, and more toward NGO contracts after some experience has been gained.

4.6 Project Administration. A constraint upon the project's operation is the provision that technical assistance and administrative support be provided by the same individual. It has been the cause of much delay and friction and should not be overlooked in approving a plan for the project's termination and transfer to the counterpart agency.

Because of administrative duties and activities not connected immediately with project objectives, the EDI contract personnel have not been able to give sufficient attention to the operation of the agroforestry centers, nor has the ministry staff assigned to the project. The Mission believes that a reasonable schedule should provide for at least one visit by a senior member of the project staff to each center at least once a month.

At the centers the Peace Corps Volunteers have the same problem. They have technical rather than administrative skills, but have had to concern themselves largely with administrative details.

## 1.0 Introduction

The project staff should be commended for the development of its six agroforestry research and training centers. The physical establishment of the centers themselves has required considerable investment in staff time and resources. Yet, because of this commitment, the Kenya Renewable Energy Project (KREP) has an important presence at the District level, one which is more apparent than many agriculture and rural development programs that have received significantly more funding. At this stage in its development, however, the agroforestry component has reached a critical point where unless more emphasis is given to extension, on-farm demonstration and monitoring of farmer agroforestry practices, center impact will be limited to a relatively small radius around the District centers. The performance of the centers to date indicates a willingness to move in this direction. But for them to do so will require some modifications in the project's approach over the next several months.

It should be noted here that the author endorses the agroforestry approach to improving smallholder energy needs and farming systems in rural Kenya, particularly in the more densely populated highland farming zones. The criticisms and recommendations made below regarding project performance should not be interpreted as a lack of support for agroforestry; nor should it be taken as an indictment against the project staff. The contractor personnel are especially well versed in agroforestry techniques and have managed the agroforestry component admirably well. The agroforestry component of the project is experimental, and this was clearly recognized at the project design stage (see Ref. 10).

I strongly feel that the Government of Kenya can learn much about addressing smallholder energy and food production problems through the approach advocated by KREP. Smallholder tree planting and its integration with food production systems have received strong support from the highest levels in government, particularly from the President himself. It is also increasingly advocated by Ministry of Agriculture personnel, and by rural farmers themselves. In addition, I feel that the project has provided an important vehicle for USAID/Kenya to improve Kenya's natural resource base and agricultural productivity through the conscious integration of cropping systems with tree resources.

## 2.0 The Appropriateness of Center Selection and the Agroforestry Approach

The project has carefully followed the center selection criteria established in the initial Project Paper. The six agroforestry centers were to be located in different ecological zones, including a semi-arid region (Kitui), a poorly drained highland zone (Ngong), the Western Lake region (Kisii), a central highland area (Wambugu), a coastal zone (Mtwapa) and a western intermediate elevation area (Bukura). I feel the project wisely added additional criteria to center selection. These included: population density; intensification of agricultural systems; and degree of fuelwood scarcity. As I will indicate below, these later three factors are more significant variables in determining the success of the agroforestry approach, than the region's ecology.

Four of the centers selected - Ngong, Bukura, Kisii and Wambugu - are located in Kenya's high potential agricultural zones where population density is very high and where agricultural systems are intensive. The



farmers around the centers usually obtain their fuelwood from their own farms. Land in these areas is individually adjudicated and access to common or state lands for fuelwood gathering is limited. Farmer recognition of the importance of tree planting is widespread, at least in the case of Kisii, Bukura and Wambugu (see Ref. 8). The rationale for the Ngong center, however, is not clear, although it was originally intended to be used as a test case for the upland, poorly drained farming areas. Its proximity to Nairobi (five miles distance) very much affects the center's performance, particularly in its tree species selection and their appropriateness to Ngong farmers, and to Kajiado residents as a whole. Most of the trees distributed to individuals of the Ngong center have gone to Nairobi residents for urban fencing and ornamental purposes. For agroforestry purposes, I think the selection of Ngong was inappropriate because ecologically it represents only a very small area of Kajiado District (most of Kajiado is extensively grazed by Maasai) and because the center's locations at Jamhuri and the Ngong Forest station make them inaccessible to the farmers of Ngong, other than the most affluent. It is now planned to make the Ngong center the national headquarters for the agroforestry centers. While this might allow Nairobi project personnel a more permanent base at one of the agroforestry centers, it should be carefully examined, particularly if it draws heavily upon resources which could be otherwise used to support the work done at the other five agroforestry centers.

From an agroforestry perspective, the selection of Mtwapa is very appropriate since local experience with fruit tree/cropping systems is extensive. The fruit tree component is likely to remain an important

element of the agroforestry work at the coast. Here, also, most of the land is individually adjudicated, and while agricultural systems are not as intensive as in the highland zones, they are more intensive than in most areas of Kenya. It is questionable, however, whether one can really speak of a fuelwood shortage at the coast, since access to palms and other species seems readily available (Ref. 8).

Kitui was a good choice as the agroforestry center representative of the semi-arid areas. It is typical of Kenya's semi-arid areas with extensive Acacia browse/grazing areas, low population density in most parts, and some dryland farming practices. In the latter respect, it is different from other ASAL areas in Kenya in the extent of crop production, particularly maize, made possible by higher rainfall in the immediate Kitui area. The Kitui center may prove a valuable testing area for the agroforestry approach in the ASALs - and for this reason alone the center is warranted. However, because it is not representative ecologically of ASALs in general, the Kitui center will need to establish research modules in the other ASAL ecological zones in the general area. It has been noted elsewhere (Ref. 44) that famine relief is often common in these areas and that whatever cultivation takes place is to supplement pastoral production. I will elaborate on the appropriateness of the agroforestry approach in the ASAL, as promoted by KREP, in Sections 3 and 4 below.

It is important that the Kisii center make a conscious effort to funnel much of its extension and on-farm demonstration efforts to the Lake Victoria Basin area. While Kisii center is part of Nyanza Province which includes the lowland Lake region, it is a highland farming area

that is not typical of most of the Province. The Lake Victoria basin is an important ecological/farming zone of Kenya and agroforestry should be tested in the area. The Lake area is densely populated relative to most Provinces of Kenya and fuelwood shortages are likely to be acute in many locations. It also is inhabited by the second largest ethnic group of Kenya, the Luo, who practice a form of agropastoralism that is combined with fishing in areas along the Lake shore. The highland bias of the project could be partially overcome by making the Kisii center more oriented to the lowland Lake region.

In general, I support the selection of five of the centers (excluding Ngong) by the project. As indicated earlier, however, I have reservations about the agroforestry approach in Kitui, as emphasized by the project (e.g., crop/tree interplanting), and more effort should be made to tailor the center to the production systems typical of the ASALs. Nevertheless, the center in Kitui will provide important comparative case material for the project in general.

### 3.0 Research

The applied research component of the agroforestry centers can be divided into on-station data collection and farm level research. The on-station applied research to date has focused on measuring tree growth rates, survival rates and crop yields in tree-crop systems. While valuable data have been collected to date, it has been uneven among the centers and has particularly suffered from lack of standardized data collection. It is important that the data collected at each center be comparable to that collected at other centers, and that the senior

staff design common data forms for each center. The center which appears to have the best data is Mtwapa where crop yields have been recorded and published, and where survival rates for different species also are available. In some centers control plots of food crops are used, and in other centers they are not.

At this point in the project, survival rates for tested tree species and yields for each crop in the crop/tree systems should be tabulated and the results analyzed for all centers. The various inputs, including the periodicity and length of watering and fertilizer application, should also be tabulated and analyzed. The results of this exercise should be made available to staff members at the different centers. For the farmer, the critical issues will be: (1) what does tree interplanting do to crop yields; (2) what are the costs incurred in tree planting; and (3) what are the expected survival rates for trees under good and average management? Much of the data to answer these questions has been collected, but in only a few centers has it been analyzed; these centers are not in a position to make recommendations.

The unique aspect of the agroforestry approach is the deliberate planting of tree species among crops. This strategy can be manifested in several ways; for example, the planting of trees around the perimeters of fields. Other cases include the planting of trees on the edges of agricultural terraces (appropriate for parts of Kitui), the random planting of trees among crops, or the deliberate interplanting of trees between rows of food crops. The emphasis in all systems is on the favorable interaction of tree and crop species. To the Kenyan farmer, the interplanting approach is the most unfamiliar form of agroforestry. Most tree/cropping systems found in rural Kenya are those

where trees are randomly distributed among crops. In many cases, the trees are left in the fields because they create a favorable microclimate and environment for crops, or because they are needed for fuelwood and building poles. To date, the project's on-station testing of crop/tree systems has been strictly limited to linear interplanting of trees with crops, or in some cases grasses. It is important that the project in both its centers and on-farm demonstrations test approaches to agroforestry other than strict tree-crop interplanting.

The off-station applied research to date has been minimal. Because the project is still at a pre-extension stage, the research focus has been on testing tree species, crop performance and seedling production. An applied research firm, the African Development and Economic Consultants (ADEC), carried out a baseline socio-economic survey for four of the six agroforestry centers. The survey provides important data on local agroforestry practices, land tenure, cropping patterns, and local perceptions regarding fuelwood shortages. The ADEC report should be carefully examined by the center extension personnel. It should also be consulted when the project begins to do follow-up data collection on those farmers who have received seedlings.

The centers to date have developed very few on-farm demonstrations in the districts where they are located. For those on-farm demonstrations now operative, as well as those planned for the next cropping season, standardized data collection also should be utilized. Information on tree survival rates, crop yields, and labor costs entailed in tree planting should be recorded. Where fertilizer has been applied and where the project has provided "casual laborers" to the farmer (such

as in the Kitui case), this also should be indicated.

As the project begins to move its efforts more toward extension, it is important that visits be made to a sample of farmers and groups (perhaps 10 percent of the total) who received seedlings over the past year. At present the centers have been recording the names of farmers, their village locations, number of seedlings, the particular species distributed, and the intended use of the seedlings. In very few cases, has the center staff visited any of the farmers to record the actual use to which the seedlings have been put. Nor has project personnel recorded tree survival rates among farmers who received seedlings. This farm level data collection should receive priority attention in the next few months. If center staff with its limited personnel cannot devote time to visit a sample of farmers, then an outside institution, such as the Institute for Development Studies, University of Nairobi or ADEC, should be contracted to monitor project impact at the farm level. The data collected from each farmer in the sample would be limited to survival rates, use of trees, type of agroforestry practiced (if any), and impact on crop production. This exercise should be carried out before the next long rains (preferably January-February) and after next year's harvest (September-October). If the agroforestry component receives the recommended no-cost, one year extension (see Section 7 in this chapter), then the same exercise should be carried out in the following year. In this case, the sample of farmers should include producers who received seedlings in 1983, as well as individuals that planted seedlings in 1984. It is important that the results of the monitoring exercise be available to project personnel in a timely fashion.

This consideration should be taken into account if it is decided to contract an outside organization. Excellent information on how to assess the agroforestry component's impact at the farm level is provided in Brokensha's report (Ref. 13).

#### 4.0 Extension and Farmer Outreach

The extension component of the project has been held in abeyance while the physical facilities and center nurseries were developed. It is important that this aspect of the centers be emphasized in the next year. Each center presently has at least one trained agriculturalist responsible for extension. This obviously is inadequate; however, the centers have partially overcome this through support of Ministry of Agriculture (MOA) extension staff. An additional extension person (perhaps a PCV) at each center would strengthen the agroforestry component. The project's coordination with MOA extension staff has been excellent at most centers. The project also should be applauded for its efforts in agroforestry training for MOA Technical Assistants. These individuals serve the farmer at the location level and their cooperation in extension is essential. What should be remembered is that the extension aspect of agroforestry is as experimental as the concept itself, and in many respects may prove more problematic than any other component of agroforestry.

The extension component of the agroforestry centers needs to be supported by the applied research. The extension staff at the centers and the extension T.A.'s must be able to convince farmers that agroforestry will have a positive impact on crop production, or at least

that any minimal tradeoffs in yields will be more than compensated for by additional fuelwood production. It is important, therefore, that the results of the on-station and on-farm demonstrations be made available to extension personnel, and that their significance be carefully explained. The field extension person must be able to answer farmers' questions about agroforestry's impact on production of food and export crops. The effect on yield is the most important priority of smallholders in Kenya.

Information on successful methods for reaching small farmers must be shared among center personnel. At present each center is tailoring its extension program to what seems appropriate for the particular center. Thus, if MOA personnel are especially cooperative in one area then they are utilized. Similarly, if a chief in a specific area is particularly supportive, then his local influence is used in reaching the farmer. While this flexible approach may be suitable for certain centers, it is important that a more standardized extension strategy for agroforestry be adopted. It is equally important that when an approach has proved successful in one area that it be attempted at the other centers. For example, the Kisii and Kitui centers have effectively used women's groups for distributing seedlings to farmers. In the Kitui case, the use of chief's "barazas" for explaining agroforestry techniques to farmers also seems effective. Both these approaches to extension should be attempted at other centers. The project must learn from both its successes and failures in agroforestry extension.

Although the agroforestry centers have been able to rely to some extent on the MOA for extension purposes, they cannot be expected to absorb the full responsibility for extension. The project should more



fully utilize local "barazas," women's groups, NGOs, and the "field day" concept. Kenya is unique in Africa for its highly developed local organizations such as women's groups. Since women are the effective farm managers in many areas of Kenya, the women's groups are especially appropriate for disseminating information and materials to farmers. In both the Kisii and Bukura center areas, prior field research has shown that women provide both the bulk of labor and managerial inputs to the agricultural system (e.g. see both P. Mook's work on Vihiga farmers and K. Staudt's research on Kisii women). In at least four of the agroforestry center areas (Kisii, Bukura, Ngong and Wambugu), considerable male off-farm employment necessitates farm managerial roles on the part of females.

The use of on-farm demonstrations is another device for disseminating seedlings and agroforestry techniques to local farmers. "Field days" should be held at each of the successful on-farm demonstrations, where the significance of agroforestry can be explained to farmers. This approach can be very useful in reaching the small farmer since (1) it is held at the farm level in the farmer's location, rather than at a formal institution; (2) the farmer can actually see the technique being advocated; and (3) farmers who rarely travel outside their location can attend. Because the project has wisely selected center staff who speak local languages, this approach to extension seems particularly well suited. It should be attempted at each of the center zones, and its effectiveness documented for comparative purposes.

Accessibility of farmers, particularly the less affluent, to the present centers is limited. In only the Bukura case is the center

located in a convenient place for farmers; that is, in proximity to a periodic market place. It is difficult for farmers without transport to take seedlings to their farms. The push toward applying agroforestry at the farm level should be complemented by decentralization of seedling distribution. The sub-center concept has been endorsed by KREP as one mechanism for providing closer distribution to the farmer. While I support the rationale for such a strategy, I think it would be inappropriate to establish subcenters with the same complement of activities and equipment as the centers (also discussed in Part I). The sub-center notion should be limited mainly to maintaining small nurseries for distribution. It should not be staffed by full-time management or research personnel. Rather the sub-center nurseries should be used to supplement the extension staff by providing easier seedling distribution. Where possible, existent nurseries, either at schools, women's groups, or at chief's residences, should be utilized. The centers can offer to support local nurseries if allowed to introduce suitable agroforestry species into their production units. The project also should experiment with helping private farmers produce their own seedlings, with the intention of using these nurseries for distribution. At least one farmer in the Kitui area has established a small nursery, and there are individuals in the Nyeri area with private nurseries. When sub-center nurseries are established in toto by the project, they should be staffed by no more than three to four full time casual laborers. The management of these sub-center nurseries should come from the center itself.

Center extension programs are seriously hampered by lack of vehicles. At present each center has only one vehicle, and this must

be shared by several staff members. Plans to provide motor bikes to each center should be expedited. My assessment of extension personnel on the project is that they are exceptionally capable and could greatly benefit from additional transport.

## 5.0 Training

The project has successfully held regional training workshops at the Coast, at Kakamega and at Kitui. These have been important sessions for publicizing the agroforestry component of the project. The project also has trained many Technical Assistants from the Ministry of Agriculture. Since these individuals have greatest contact with farmers, this strategy should prove particularly beneficial and should be emphasized at all centers. Most of the farmers' training to date has been limited to the Farmer Training Centers (the Better Living Institute in the case of Kitui) where staff members are allowed to lecture for one to two class periods per session. While it has perhaps been a prudent approach to date since the FTCs are well established training institutes, alternative approaches should be sought for the coming year. Training sessions at the FTCs tend to be dominated by the more affluent farmers who are not representative of the majority of Kenyan farmers. The FTCs also are usually located at the District centers where most neighbouring farmers have substantial off-farm employment (including civil servant positions) and enterprises. For other farmers, the District centers are remote, and require substantial transport costs to be reached.

The "field day" approach mentioned above and other less formal training sessions should be attempted at the local levels. Training often is more appropriate if the session is held in the farmers'

neighborhood. Materials should be developed, including visual displays for illiterate farmers, that are suitable to local training at the sub-district level. Local schools might be one vehicle for holding short, one-day training sessions for farmers. Again, because some center staff members speak a local language and all are fluent in Swahili, this more decentralized form of training could prove useful.

It also is important that at least one short workshop for center staff be held in Nairobi, preferably before the next planting season. While communication among centers seems adequate, I think center staff should be exposed to approaches and activities tested at centers other than their own. Since the project is still at a learning stage, project lessons and experience must be communicated among the different centers.

#### 6.0 Integration With Farming Systems

I have indicated above my support for the agroforestry approach in the high population, intensively cultivated zones. These would include the Bukura, Kisii, Wambugu and Ngong (at least in Ngong Division) center areas. In these areas, agricultural intensification is considerable, including fodder production for animals and use of high-yielding crop varieties. Because land holdings in these areas are small and access to common lands is limited, farmers cannot afford the luxury of having a portion of their land reserved for tree lots. The opportunity costs of land in these areas is such that almost all available land is put to productive use. Since fuelwood shortages are acute in these areas, wood resources must be integrated with the cropping/livestock system itself. A household's fuelwood needs will increasingly have to

come from the farm fields themselves justifying an agroforestry approach in these areas. What should be remembered is that when the total food system is examined, including inputs for processing and cooking food, much of the labor and energy inputs (including labor allocated to wood gathering) after the production (or harvesting) of food will affect the food production process.

The agroforestry approach as outlined for the high potential areas is not appropriate for the marginal zones. The interplanting of trees and crops on the same plot in these areas cannot be justified in terms of fuelwood needs, or maximization of household needs per land unit. In most of Kitui, for example, availability of land is not a constraint to production; rather water and soil loss are more critical. Moreover, Kitui is not a fuelwood deficit area. On the contrary, it is a net exporter of energy in the form of both fuelwood and charcoal. Thus, the rationale and approach to agroforestry in this area must be different than for the other areas.

The promotion of tree planting in Kitui must be closely linked to the production system. It must recognize the unique set of constraints semi-arid areas face and tailor the program to address these problems. Caution is warranted for those who feel quick results are possible. The lack of prior attention and infrastructure in these areas makes this difficult. There are ways, however, in which agroforestry can assist in the development of Kitui. First, it must be tailored to an extensive form of agropastoralism where in many areas the emphasis is on the livestock component. This implies that the agroforestry center at Kitui must actively promote fodder species, and recognize that tree/crop

interplanting may be appropriate for only a small percentage of farmers in Kitui's Central Division. In this respect, the Kitui center should be in touch with the District's range extension officers and be familiar with the species they are promoting. Because of its extensive nature, the integration of tree planting with pastoral livestock production is problematic. In areas where land is held in trust by the community, the center must deal with groups, not individuals.

The form of terrace agriculture practiced by the Wakamba in both the Machakos and Kitui Districts should be considered in the center's agroforestry work. Much of the rationale for this system lies in its effectiveness for conserving soil and water. Tree planting along the perimeters of such terraces is promoted by the Ministry of Agriculture's (MOA) Soil and Water Conservation Department. The project should carefully examine what MOA is doing and attempt to identify the ways in which an agroforestry approach can address soil erosion and the problem of water constraints. The Kitui center must experiment with a range of approaches to agroforestry and tree planting.

#### 7.0 Center Management and Coordination

The management of the centers has been particularly labor intensive in terms of both center personnel and Nairobi headquarters personnel. Much of the day-to-day management/administrative responsibilities of the center staff could be effectively minimized if the project placed administrative clerks at each center (this has been proposed by MOE but has not yet been implemented). At present the extension, research and training components of the centers have been hampered due to ex-

cessive administration requirements for staff members.

It is important for the coming year that detailed work plans and budgets be made for each center. There presently is no indication, for example, of how center budgets are made. At some centers the number of full-time casual laborers is more than twofold that of other centers. Is this reflected in budget plans? The budget for the coming year must be detailed and reflect the differential workloads at the various centers. They must also be complemented by a detailed workplan indicating what the particular center hopes to achieve in the next year, and what inputs are required to do this. The implementation plans for each center are too general to be used as actual workplans. These plans also do not adequately reflect the different requirements of each center.

The recommended Management Advisory Groups (MAG) for most centers have never effectively met. It is questionable, however, whether this has had any negative effect on the project. Project personnel have been effective, in most cases, in acquiring local support from relevant individuals, ministries and local bodies. The only advantage that the MAG would give the centers is a link to the District Development Committees. These organizations are important in many Districts, particularly in their role in formulating District development priorities. In only one case (Kakamega), did the evaluation team find evidence that an agroforestry center was listed in a District Development Plan (1984-1988). It is important that the agroforestry centers be mentioned in these plans, and that MOE provide estimated center budgets to be included in them. Unless MOE has put a line item in its budget (which

should still be reflected in the district plans), there will be no precedent to maintain the centers after the end of KREP's external funding.

The agroforestry centers could more effectively coordinate their nursery activities with those of other nurseries in Kenya. This coordination will be important in the coming year when extension activities accelerate. There are no less than thirty-five donor supported projects (government and non-government) in Kenya that are presently distributing seedlings. This figure does not include the several missionary, chief and other small nurseries in the rural areas. It is important that each agroforestry center be aware of nurseries in their districts, of the species they are advocating, and of how effective they have been. The center or sub-center nurseries should not be duplicating what could essentially be done in other nurseries.

At present it is beneficial that the agroforestry programme is under the Ministry of Energy. Neither the Ministry of Agriculture nor the Forestry Department of the Ministry of Environment and Natural Resources has adequate experience with agroforestry techniques. Moreover, had the project been placed in either MOA or MENR it is likely that it would have received less attention than it has under MOE. Because MOE is a relatively new ministry without as many projects as other ministries, it has been able to direct sufficient attention to KREP. However, after project completion there is a question of what institutional affiliation the agroforestry centers should have. If MOE is willing to make a commitment for coordinating the centers and maintaining cooperation with the field-oriented ministries (MOA and MENR), then a strong case could be made for keeping the centers under



MOE. At least in this case, the energy/fuelwood emphasis would remain salient. This dimension might be less if the project is placed in either MOA or MENR. On the other hand, the lack of a strong commitment for the centers on the part of MOE would argue strongly for placing the centers under MOA. The advantage of this latter strategy is that the center would have strong field support, and might be able to attract agricultural research funds that it might not have access to otherwise. In short, the question of an institutional base for the centers after project completion should be resolved within the next few months. Moreover, it is MOE which should initiate this.

#### 8.0 Summary of Recommendations and Priorities for Future Activities at the Agroforestry Centers

Below are summarized the main points of the evaluation of the agroforestry component:

- Because the centers are just now beginning to promote extension at the farm level, it is justified that the length of the project be extended (at no additional funding) for one year after the scheduled completion date of September 30, 1984, or at least until July 1, 1985. I think the project's performance to date warrants this extension. Project benefits would be minimized if additional time is not given for extension and farm monitoring.
- The narrow definition of agroforestry (i.e., tree/crop interplanting) used by KREP should be expanded to include other agroforestry approaches.
- Data collection at the centers should be standardized. Analysis

- of collected data should be undertaken in the immediate future.
- The approach to both extension and training should be decentralized. Alternative methods to extension and training should be attempted. These are discussed in detail in Section IV and V.
  - Off-station research should be directed toward assessing what farmers have done with distributed seedlings. A sample of farmers from the center lists should be selected, and prior to the next planting season they should be contacted. The data collected from each farmer in the sample would be limited to survival rates, use of trees, type of agroforestry practiced (if any), and impact on crop production.
  - The project must have a commitment from MOE or MOA that they will maintain the centers after project completion. This commitment should be sought as soon as possible.
  - The centers should be given additional administrative support. MOE administrative clerks should be attached to each center.
  - The project must be coordinated more closely with existent nurseries in the Districts. If possible, existent nurseries should be supported as seedling distribution points, rather than establishing separate sub-center nurseries. Where sub-center nurseries are developed, they should be only for seedling production and distribution purposes. Management of the sub-centers should be from the center staff.

## 1.0 Introduction

Initially KREDP was set up to cover a range of topics, most of which appeared superficially to be interdependent. It is now clear that the interdependencies are in places tenuous from a practical viewpoint. For instance, the amount of wood burned has little effect on oil imports, as wood users generally have no economic option to switch to fossil fuels. Similarly, excessive industrial fuel use has little bearing on wood burners, except insofar as it can weaken the country's economy overall, affecting everyone to some degree. Thus it seems relevant to examine which topics have been identified as important, and where the links and breaks between them fall.

Examined closely, stove improvement and better charcoal production break fairly clearly into three separate projects:

Part A Effecting economies in domestic charcoal use.

Part B Improving rural life by improved cooking techniques.

Part C Slowing the rate of expansion of the charcoal market.

Part A affects mainly urban people, and will have an effect on Part C. It is progressing well, and is an exemplary case of sensitivity to local conditions, creating a self-financed production system for a fuel-saving device. Work on Part A is now substantially complete.

Part B is in many ways a rural improvement project. Its success would decrease time and money needed to provide firewood, improve kitchen efficiency and hygiene, make life much easier for rural women, and possibly decrease erosion and deforestation.

Using experience and contacts gained in Part A, the Project is now beginning trials on a number of diverse woodburning devices. Part B will be more complex and difficult. It is unlikely to see full resolution within the period allocated to it.

Part C falls into two tasks: improving the efficiency of the thousands of existing small charcoal producers and ensuring that all new production is regulated and efficient. Work on both parts has been slow to start.

## 2.0 Charcoal Stoves

The introduction of stoves is essentially experimental. The oldest improved stoves programs are less than five years old, too soon to make conclusive pronouncements on their success or the wider effects they may have on the local economy and society. Also, stoves are culture-specific. Therefore, models and dissemination systems developed elsewhere cannot be adopted wholesale to the Kenyan situation, which has peculiarities of its own. Results of such projects are usually unpredictable and sometimes unquantifiable. In Kenya's case, the technologies not only need to be distributed, but developed as well. The Project has set itself a difficult task.

It is in the nature of experiments that many of them fail. In the field of improved cookstoves successes have to date been rare and small in scale. Thus, the obvious widespread success of improved charcoal stoves in Kenya merits close analysis. Already the Project has attracted worldwide attention and it will doubtless be carefully watched for its applicability in other countries.

2.1 Success of the Project in Promoting Charcoal Stoves. Kenya provides a particularly favorable environment for an experimental national stove project. It has good communication infrastructure, a high standard of literacy, a national language, a well-developed commercial marketing system, a population accustomed to buying consumer items, considerable respect for government, a huge number of NGOs and extension workers of all kinds, and copious overseas aid. By first identifying an existing product (the scrapmetal jiko), existing skills (there are jiko makers in each of the country's 41 urban centers with populations over 2,000), and an existing marketing system, the strategy has been: (i) to insulate the metal jiko with a lowfired terracotta and/or cement/vermiculite lining; (ii) to arrange mass production of both parts of the stove at a small workshop scale; (iii) to conduct limited laboratory tests and household trials; and (iv) to provide training workshops for both trainers and artisans.

Distribution of stoves has taken place through informal markets, spurred by consumer demand. Without widespread publicity, there is already a demand that exceeds production. Information has spread by word of mouth. Customers in shops have seen the stoves, asked about them, and purchased the items.

With a four-stage production, distribution system, there are at least three points at which quality is controlled. The assembler insists on quality from both the maker of the liner and the maker of the cladding; the retailer demands quality from the manufacturer; and customers select for quality, forcing higher quality from the maker.

The Project has carefully involved local businesses in a system which demonstrably offers bigger profits and expanded markets for them.

At least three private businesses have been shown the potential in stoves. One is Clayworks, the country's main brick producer. Clayworks sold 7,600 liners to traditional jiko makers in Nairobi between November 1982 and August 1983. Their quality is rather poor. By August 1983 the company had a monthly production of 2,600; production then stopped and they are now disposing of the surplus.

Jerri International made 3,500 ceramic liners in the first nine months of 1983. Jiko makers bought 1,500; the remaining 2,000 were assembled and wholesaled to retailers, mainly on River Road in Nairobi. The firm also has an arrangement with Kenya Farmers' Association (KFA), which retails through shops all over the country. Sales are reported to be brisk; the Nanyuki KFA alone is selling 100 a month. Jerri's owner, Mr. Kimani, is a very successful businessman. He is taking improved jikos seriously and has reportedly said his aim is to produce 400 a day at a price of 25/-. He has attracted two skilled workers from Clayworks, has installed a new kiln exclusively for stove liners, and has bought a clay crusher.

At Shauri Moyo, Nairobi, 22 artisans are now employed, making 2,600 metal claddings a month. About one-third are assembled and sold on the spot or are wholesaled through shops; the remainder are sold to Jerri International or Clayworks.

In Western Kenya, Ilesi Pottery at Kakamega had made 300 liners and 45 all-ceramic wood-burning stoves up to October 1983.

At Mtwapa, Mombasa, production began May 1983, mainly of bellbottom and straight claddings, all with a cement/vermiculite lining. By October 1983, 250 had been sold.

Nationwide production increased from a very minimal number in early 1983 to 500 per month by October 1983. Improved jikos cost from about 65/- to 200/- depending upon the retailer; an unlined model the same size costs 20/- to 40/-. Despite the higher costs, users are claiming improved stoves pay for themselves in a couple of months. Quite consistently I found users telling me they were saving half the fuel used previously.

A couple was encountered at Jerri International, returning two clay-lined jikos for repair. One was 12 months old, the other newer. They were used, they said, up to 12 hours a day, and both were returned only because the ceramic grate had cracked, a 5/- repair. They both agreed that the jikos saved a lot of charcoal: "We used a bag every two weeks; now a bag lasts a month." The family was of average size--that is, of six people.

It is my conclusion that without any additional help, the new jikos will continue to spread and diversify. Profits to the producer are considerably higher than from the traditional model, so there is high incentive to market aggressively.

Charcoal jikos are in a state of rapid evolution, new designs appearing spontaneously in rapid succession. Potters and metalworkers see opportunity in a big new market and are competing for different niches in a diverse economy. We can expect further design evolution in the next year, possibly toward (i) less metal, more ceramic materials; (ii) expensive carefully finished middle-class models; (iii) portable stoves specifically for wood.

There are shortcomings in leaving the producers entirely alone at this stage. An unsophisticated buyer can be sold inferior products. Already stoves have been produced without the cement/vermiculite insulation with the claim that they save fuel. The public will need to learn how to tell a good stove and how to operate it. Also, with one manufacturer trying to monopolize the market, if competitors are unable to learn the new skill and establish businesses, it is possible the price will remain a problem for the poorest families. The stoves could remain a high-profit item available only to those who can pay 100/- to 200/-.

Finally, I should comment on the universal enthusiasm I heard for the new jikos--from manufacturers, trainers, development agencies, and above all, users. In a spate of zest, artisans are evolving new ideas and producing new models faster than can be tabulated. It would be valuable to seek out and test all of these innovations as soon as they appear.

## 2.2 Problems and Recommendations for Solutions.

A. Improved charcoal jikos, to reach universal acceptance at low cost, still need some assistance. Particularly, training is needed for the large numbers of artisans who at present make insulated models. Funds need to be released for such training. There have been disappointments and disillusionment on the part of several NGOs, as money promised to them has been held up by MOE. Constraints to a rapid flow of funds out of the EDF should be identified; personnel incapable of handling these responsibilities should be replaced.

B. Technical clumsiness of earlier models is being tidied up. The full-depth clay liner, for instance, is hard to light and is unnecessarily heavy, so it is now being replaced with a shorter



liner. Metal grates burn out rapidly and should be discouraged. A metal liner quickly works loose and appears to have little purpose, and so should be discarded. Cement/vermiculite degrades rapidly and may need to be reconsidered as the firebox liner (though as added insulation behind fired clay it seems to be excellent).

C. At the six agroforestry centers, stove technicians are being hired to run training courses and do extension work. The artisan/trainers who will staff the agroforestry centers should accomplish their main task within 12 to 18 months by training local jiko makers in techniques of building and using the new charcoal stoves. At that point, having been employed at most two years, they too will probably have to set up an independent enterprise. Demand for the new stoves will ensure continuous expansion of businesses in each of the areas served by the centers.

Thus, none of the jiko trainers will need to be permanent MOE staff. Indeed, with 2,000 to 3,000 Kenya shillings a month to be made in production, it would be unreasonable for them to work at current MOE pay scales. If the centers are to retain these vital workers for longer than a few months, they need to see financial advantages that would keep them from leaving to set up businesses of their own. It should be noted that there is a dilemma stemming from success in exactly those things the project was designed for--to create financially viable self-sustaining businesses.

However, if trainers can be persuaded to stay at the centers for an extended period of time, the system will stimulate a constant output of artisans who will go out on their own. Solutions

might include a higher salary as a 12-month contractor, EDI paying the balance of a competitive salary, or a bonus of special training possibilities after 12 or 18 months of continuous service.

D. Kenya has an unusual number of effective NGOs with field experience. Groups such as Maendeleo ya Wanawake, ATAC, and the coordinating body KENGO are Kenyan staffed. Their personnel are educated, able, and impressive. Given small financial support they can stretch funding and make good use of resources. The process of household testing, broad-scale training, and disseminating techniques of fuel saving is proceeding well in their hands, and without them it is doubtful the project would succeed. Their cooperation especially will be necessary for the next step: development and diffusion of wood-burning stoves. The EDF was allotted funds specifically to help the efforts of organizations of this kind, yet without exception I have heard only complaints about management of the fund. Unnecessary delays, disorganization, lack of clarity from MOE, and noncooperation from MOE staff have been consistent patterns. One group, promised funding in February 1983, still had no word of why the money was delayed nine months later. At the time of writing, less than 5 percent of the \$644,000 fund had been disbursed. It has been pointed out that mismanagement of this fund, in addition to creating needless delays, frustration, and administrative work, has tarnished both AID's and MOE's reputation and is seriously affecting the ability of some key NGOs to find other financial support. Donor agencies are unlikely to support a project when it is well known that a large portion of EDF remains unspent, and to outsiders the inability of

an NGO to get funding from this obvious source can weaken its status as a competent, credible body.

E. Monitoring and follow-up work are needed. The new jikos operate differently and need different care from the all-metal version. For instance, cooks are accustomed to quench the coals by pouring on water. Hot cement/vermiculite degrades rapidly if cold water is poured onto it, so cooks need to empty the coals before quenching. All-metal stoves are robust: ash is usually shaken down by rattling the whole stove; such stoves get thrown up on the roofs of buses and generally abused without problems. The new stoves need more careful handling--for instance, by removing the ash by stirring the coals, and by keeping them out of the rain.

Female Kenyan extension agents should be employed (i) to train cooks in such fuel-saving techniques as closing jiko doors, using pot lids, and quenching coals; and (ii) to make house visits to all users of the new stoves after about a month's use. They should record basic information on durability, amount of use, and the cook's likes and dislikes. At agroforestry centers the feedback can go directly to the stove trainer to embody in design refinements. In Nairobi, information can be fed to private manufacturers.

One extension agent should be hired for each center immediately, to be given basic instruction by the trainers, and then begin work following up stoves as they are distributed. Agents can be increased if production merits it. Duties would also include a basic survey of woodburning and cooking habits in the areas in which agents are stationed, to be carried out during routine stove

inspection visits.

The importance of follow-up and extension cannot be overstressed. A visit to Meru Hospital, where about six improved jikos had been provided several months before, revealed the abandoned stoves dumped in a back room. The cook complained of several inadequacies in design and performance and had little good to say about the improved stoves. They had been too slow-burning, he said. The thin metal grates had burned out within two weeks (with no support provided for replacements), and the cement/vermiculite was unable to bear the heat. The man seemed bitter and disillusioned. No one had ever returned to give him help or to check on his progress. Here is a case where it may now be difficult to introduce improved stoves, as word travels fast in Kenya and the whole town may be alerted to believe that improved jikos are a waste of money.

### 3.0 Woodburning Stoves

Kenya's population is still 80-90 percent rural. A high proportion of the two to three million families cook daily on open fires, using three stones to support the pot. They burn firewood, probably on the order of one ton per person per year. Most of the firewood now used is small diameter (less than five cms), in lengths between 50 cms and 1 meter. It is gathered rather than felled, though a panga (machete) may be used to prune trees and trim bushes. In some areas, almost all wood is owned by an individual, so landless people or people with tiny acreages must buy it.

In the case of charcoal stoves, the new models merely replace the old; a market system already exists. Wood burners have no tradition

of sophisticated stoves; the process of disseminating a stove among them is likely to be slower and more difficult.

The three-stone fire has manifest advantages: stones are free; you can see the fire, so it is easy to tend; it heats and lights you. Despite a promise of economy, it is hard to see benefit in replacing the fire with a device lacking these features. A stove needs to have overriding advantages of its own. Particularly difficult is the concept of paying for a stove when there will be no cash saved in fuel costs.

As elsewhere in the Third World, the big debate on rural stoves for Kenya will be the choice of promoting either a no-cost, owner-built stove of local materials or a purchased, manufactured article. The case for manufactured stoves rests on their potential for rapidly being available to large numbers of people. Owner-built stoves (or fixed stoves built in place by local artisans) have been introduced in other countries--e.g., Senegal, Guatemala, Java, and Nepal--but the rate of diffusion has been slow. The general consensus from EDI and many other promoters in Nairobi is that this slowness is inherent in the dissemination system--that it would be impossible to offer fixed stoves to most of the rural population in a short time. Conversely, there is no evidence that manufactured stoves would catch on rapidly nationwide. There is a tendency for Nairobi-based managers to extrapolate from the success of an urban sales program, imagining that rural people will respond similarly. Several groups working from the rural end believe the opposite: that rural cooks will see little advantage to a city-made device that costs hard cash to buy.

Proposals. Speculation at this point is fun, but precious energy is being wasted in theoretical debate while Project time and funds are running out.

The issue is more the type of stove model than what production/dissemination system should be used. That system will itself define the type of stove. Already there are probably a dozen groups working on stoves in Kenya. I recommend that until much more is known about the probability of success for one method or another, any kind of stove program dealing with rural stoves should be encouraged and supported. It should be the Project's job to ensure financial and technical support and encouragement for these projects.

The overall goal will be to monitor and evaluate, and then select the more promising systems for promotion. More systematic observations are needed of local cooking practices, indigenous stoves, and fuel-saving techniques. Following the charcoal stove program's successful strategy of improving a local technology and working in a cash economy, perhaps developments of efficient fuelwood stoves could be introduced first in areas where much of the fuel is purchased. Possibly a system could be tried based on a successful trial abroad (see examples from Lesotho, Togo, Guatemala, Upper Volta, and Senegal).

As Mr. Kinyanjui, who already appears to be overburdened with duties, is leaving the Project soon, I recommend that a replacement be hired before he leaves, to ensure continuity, and that an additional short-term expert with broad experience from other countries' programs be engaged to give further impetus to the program. By late 1984 or early 1985, three to five stove production/dissemination centers

should be located for a drive to increase the use of more efficient stoves. It is unrealistic to expect the project to accomplish this goal in the next few months. I recommend a no-cost, one-year extension of this part of the project.

#### 4.0 Charcoal Production

Existing charcoal production in Kenya is extremely difficult to regulate. Over 90 percent is produced sporadically by small farmers and country people who burn as little as one or two cubic meters at a time, yielding half a dozen or so bags. This happens seasonally when farm work is slow, at times when forested land is cleared for agriculture, and when people are particularly short of cash. Efficiency of production is low: 9-14 percent (Kamweti) from the open-pit kilns. The country produces about 700,000 tons, using 5-7 million tons of wood. Unlike the wood for domestic fires, the kiln fuel is generally whole live trees and is usually of dimensions bigger than those burnt in open fires. Firewood is collected from twigs too small to be worth carbonizing.

Charcoal use is increasing rapidly; urban growth rates of 7 percent are doubling demand every ten years. Additionally, as rural dwellers achieve higher standards of living they too join the charcoal users, so today's demand for 700,000 tons could well be 3,000,000 by the end of the century, necessitating up to 30 million tons of wood, at current efficiencies of production.

With the post-independence rush to clear land tapering off, it seems unlikely that small producers will be able to supply this additional demand, which may outstrip current production four times

by the year 2000. An 80 percent saturation by improved jikos saving 40 percent charcoal would reduce total demand by a third, yet the shortfall at current rates of charcoal production efficiencies would still require 10-15 million tons of firewood annually, in addition to what is now produced.

Efficiency could probably be improved by 30-50 percent through existing techniques that use a minimum of capital. If half of the producers increased their yield by 40 percent it would yield an additional 200,000 tons, or save about a million tons of fuel. At 25/ per bag wholesale, this extra 40 percent production could bring added income of 150 million shillings per year to rural dwellers.

Who will supply the balance? Even under the most optimistic scenario of improved small-scale efficiencies, the one-million-ton saving will hardly make a dent in the 10-15 million tons of wood needed annually by year 2000. If all the new production came from high-yield kilns, it would still require 5-10 million tons. It is unclear whether these volumes of wood are available. Certainly, transport becomes more problematic and costly as the charcoal frontier recedes from the towns. MOE is tentatively suggesting giant plantations to fuel Nairobi, located close to the city to reduce transport costs. Even so, at an ambitious wood yield of ten tons per hectare per year, plantations of between one-half and one million hectares would be needed, a formidable task requiring giant nurseries, "armies" of planters, and huge investment.



4.1 Progress to Date. As charcoal prices rise it will become more attractive for private entrepreneurs to establish plantations specifically for charcoal. This is already taking place in some regions. For example, a private business has a project 50 kms from Mombasa to stock 1,200 Ha for charcoal production. The land is publicly owned, and rented from the government on a 30-year lease. Charcoal will be sold in Mombasa, which uses about 50,000 tons per year at present. At 20 tons/Ha/year, and using improved kilns with 25 percent yield, these could produce 12 percent of present demand.

When sufficient data are available regarding the viewpoint of producers, the agroforestry centers could perhaps include charcoal production in their basic courses for farmers. Unfortunately, in a competitive market farmers are less likely to teach one another improved production techniques. A system of small producer cooperatives might help to spread information and create a better economy of scale, using larger kilns in locations central to the coop members.

The new agroforestry centers--though it is hard to predict policies at this early stage--seem not to prioritize fuel production or cropping methods in their choice of species. It is not clear whether they advise farmers on harvesting systems or high-yield species for either charcoal or firewood. Even if they do, their outreach is limited, and it may take a long time to make any significant impact.

At the Ngong Agroforestry Center, a 20 cubic meter capacity Argentinian brick kiln for charcoal making is being installed, and other kilns are planned. It may be premature to build a medium-scale industrial kiln at a time when plantations for charcoal production

are hardly more than at a proposal stage. At present there would be more benefit in using simpler mobile equipment, such as pit covers and metal chimneys. Center staff could demonstrate their effectiveness to farmers attending courses and demonstrations.

The Project appears at present to have no clear plans for improvement of charcoal production methods. The task is complicated, and requires a sensitive investigation of the social conditions under which charcoal is now produced. Also, there should be a national plan to help producers improve efficiency. Overall, the situation is confused. Neither MOE nor EDI seems to have a clear plan for action regarding charcoal production.

4.2 Proposals. If the Project is to pursue an involvement in charcoal production, it needs to assemble a more comprehensive information base than is at present available. A short-term consultant team should be engaged to survey both the technical and social aspects of the charcoal production industry. It should investigate production and distribution systems in other countries for comparison, and should work together as a tight team, both surveying and facilitating simultaneously.

The Project should allocate consultant time to help create a national policy on charcoal production, covering technical assistance to small producers, constraints on methods used by licensed charcoal makers, and the allocation of land and funding for peri-urban fuel plantations.

Both field surveys and literature searches are needed to present a comprehensive picture. Traditional kiln efficiencies need to be

carefully measured; the precise connections between producers, transport, wholesalers, and retailers should be unravelled; quantitative measures of present production zones should pinpoint where action could be most effective geographically.

The non-industrial charcoal producers could perhaps be helped to raise efficiencies (i) by making local indigenous techniques of production better known nationally; (ii) by employing obviously successful producers to train others at the agroforestry centers; and (iii) by making simple kiln equipment such as pit covers and simple chimneys available for inspection and trial at the centers.

Government regulation of producers is manifestly a failure. Further involvement of any part of the government at this stage will probably be counter-productive due to the secretive and often illegal nature of charcoal production. Any attempt to offer better techniques should come from a position of sympathy for the difficulties of the small producers, not from public authorities enforcing regulations.

## 5.0 Final Remarks

Experimental projects need more than management; they require enthusiasm. The curiosity to explore, invent, try new things is essential to their existence. Agroforestry is in its infancy. Stoves as a means of energy saving have been discussed for only about six years. Charcoal production techniques have until recently been localized: there is little information on their successes and failures.

It is noticeable that the parts of this Project that are progressing are those where an enthusiast has been involved and encouraged.

The entire EDI staff is to be commended for excitement and zeal in managing the project; in particular, Maxwell Kinyanjui's tireless and inventive pursuit of pragmatic solutions is remarkable. Mr. Kinyanjui is, however, scheduled to leave in March 1984, at a critical time for his input to the next phase, woodburning rural stoves.

The USAID Mission still seems to see stoves as an energy issue, therefore outside their new CDSS. Yet the 1983 CDSS indicates " . . . Priority 1, increased rural production, employment, and income . . . . 99 percent of the poor are rural." As suggested on the first page of this section of the report, though Part A is largely an energy issue, Part B is a matter of improved rural life. Specifically this means less money or time spent on fuel, releasing women for farm productivity, stimulating local stove businesses, and creating both employment and income. A strong case can be made that Parts B and C both fall squarely into AID's priorities as depicted in the CDSS, and are eligible for continuing Mission support.

AID should consider carefully whether perhaps the agroforestry and charcoal components would not be better served in the Ministry of Agriculture than in MOE. Development of woodburning stoves, already being tackled by a host of NGOs, might be accelerated by giving responsibility to a coordinating body such as KENGO, or perhaps Mazingera Institute.

I am unable to find an adequate survey of cooking habits and use of fires for Kenya. Prior to developing woodburning stoves, this information should be collected. Nobody seems certain, for instance, of the most common pot sizes used, the influence of altitude

on cooking duration or the amounts of wood burned. Is cooking with green fuel common? How much do people rely on open fires for warmth and light? How many rural people buy their fuel? If some of this information is not available, an ongoing survey could be built into the work of stove extensionists, or a special study should be commissioned. Monica Opole's studies on the production of jikos are concise and thorough. Miss Opole could be approached to supervise such a study.

There is much talk about the need for publicity, especially about stoves. Any product should ideally be so good that it needs no advertising. With demand outstripping production, improved jikos are selling themselves through "word of mouth." There is another kind of publicity, however, that could be most helpful--a national effort to raise awareness of the diverse ways to save fuel.

This could take the form of newspaper articles, radio shows, or written leaflets. National competitions have been used elsewhere to generate new stove models. Perhaps more appropriate to Kenya would be a competition for a workable dissemination system. There have been plans for bumper stickers, T-shirts, and hats. In Senegal, newspaper cartoons were used and messages on matchboxes: "Save fuel; use an improved stove."

There is always a risk of using culturally inappropriate messages. Local people should always be consulted before trying such strategies. Above all, publicity should focus on specific information and usable techniques, not empty exhortations to save fuel.

Should publicity be left to other organizations? UNICEF, for example, already has considerable experience in this area. Project managers will need to decide how much effort to put into this in the time remaining to them.

## 6.0 Summary of Conclusions

6.1 The Project wisely chose to focus first on the provision of charcoal stoves, rather than wood stoves or charcoal production. The assessment that this concentration would yield greatest results in a limited time has been well justified.

6.2 The improved charcoal stoves are a clear success. The demand is ahead of production and most users seem very enthusiastic about them. Production is accelerating and a self-sustaining industry has been created.

6.3 If current trends continue, improved charcoal stoves will largely replace the uninsulated model within a very few years, saving 10-15 percent of Kenya's woodfuel consumption.

6.4 Charcoal production is more environmentally damaging than the casual gathering of firewood. It takes whole live trees and encourages total clearance. Charcoal represents the highest quality fuel. However, its use requires from two to four times as much wood as when wood is burned directly. Therefore, it is important not to attract new charcoal users. An attractive charcoal stove may convert some wood users to charcoal, accelerating demand for charcoal if an equally attractive woodburning stove is not available.

6.5 The charcoal industry is dispersed, with sporadic production by numerous casual producers. These producers are unregulated, unrecognized, and often illegal. Although their methods are clearly inefficient, improving their efficiency will be a difficult and lengthy task. There is, however, an immediate opportunity to regulate production of the organized charcoal industry that is beginning to emerge. Both tasks need careful study by a specialist team before action is taken.

6.6 Attention should now switch to woodburning stoves for rural areas. They need to be attractive, fuel-saving, and relatively smoke free. About ten times as many households burn wood as burn charcoal.

6.7 Introducing wood stoves will take longer than introducing the improved charcoal stoves. The Project should be extended for one year to allow time for this. Work should now concentrate on liaison with organizations already working on the problem.

6.8 Experimental work needs both enthusiasm and extraordinary effort. Administrators should give more encouragement to experimenters and must ensure that EDF funds are made promptly available.

Part IV

Evaluation Conclusions and Recommendations



## 1.0 Conclusions

1.1 The concepts and structure of this project have made its progress difficult and should be considered in planning when and how to terminate AID's participation in the activities which the project has initiated.

1.2 The outstanding success of the project has been the design and dissemination of improved charcoal stoves. The fuel conservation program has brought about some specific and measurable savings, and has shown the way to many more.

1.3 The most difficult and ambitious part of the project has been the establishment of the six energy/agroforestry centers, not only in a physical sense, but in achieving an identity and purpose. The contribution of the Peace Corps Volunteers has been outstanding. Because the centers are so recent, their contributions to the goals of the project are not large, but their potential is very significant.

1.4 The project has made almost no progress with wood-burning stoves, charcoal kilns, sources of site-specific renewable energies and wood-producing options other than agroforestry.

1.5 The Energy Development Fund has been an almost complete failure.

1.6 The Beijer Fuelwood Cycle Study and the LEAP model are not well integrated into the goals of the project and have made very little contribution so far toward these goals. They have a large potential to advance the project's specific purpose of establishing a capability in the Ministry to formulate policy and to plan.

1.7 The project has brought about more attention to reforestation in the Government's public pronouncements. Budgets approved by the Ministry of Finance and Planning are reflecting that change.

1.8 The extent to which the project has achieved the specific purpose of establishing a capability in the Ministry of Energy and Regional Development is still uncertain. The EDI contract staff is still carrying the main burden, and the counterparts to the LEAP model still require much training.

## 2.0 Recommendations

2.1 In order to provide for an orderly withdrawal of AID project activities support and a transition to GOK support, AID should require the project staff to prepare a revised budget and work plan for that withdrawal and transition. AID should agree to a no-cost extension only insofar as the plan of work indicates what will be done during the extended period, the extent to which the GOK will assume responsibilities, and how funds will be used. Although the plan should be flexible regarding the termination of the various parts of the project, the start of the fiscal year 1985/1986 (July 1, 1985) appears to be a reasonable choice for completion. The most important tests of judging the plan's operation will be:

- the extent to which the GOK recruits or assigns personnel to project activities, and
- the provisions made in the fiscal year 1985-1986 budget approved by the Ministry of Finance and Planning for the continuation of project activities.

2.2 AID should require the Government of Kenya to respect the obligations entered into in the following documents:

- Project Grant Agreement Section 5.2 regarding donor coordination through quarterly reports and an annual donors' meeting.
- Project Grant Agreement Section 5.5 regarding project coordination through the Inter-Ministerial Committee on Energy that provides periodic review of progress and examination of the project usefulness.
- Project Implementation Letter No. 1 of September 22, 1980, Section X B1. that provides for Quarterly Progress Reports.

2.3 AID should insist that the level of responsibility and decision-making for the project within the Ministry of Energy and Regional Development be raised to a level immediately under the Permanent Secretary.

2.4 Operations of the Energy Development Fund must be simplified and redirected toward financing studies and stimulating private-sector, energy-related enterprises. It will handle the other activities listed in the Project Paper principally through contracts with NGOs and give attention to government agencies as experience is gained and opportunities appear.

2.5 The energy/agroforestry centers should become renewable energy centers and remain in the Ministry of Energy and Regional Development as focal points of innovation and synthesis. Suggestions for new or expanded on-site activities are the following:

- Further research on the practical application of windmills and bio-gas to farm life;
- Demonstration of improved charcoal-making with pit kilns, better wood-working tools, cooking equipment, and wood stoves;
- Ways to spread the use of improved charcoal stoves among the urban poor.

2.6 Now that some of the center activities have become routine and mobile equipment is about to arrive, the project should put far more emphasis on extending the range of the centers' influence. Suggestions for doing so are the following:

- Increase the sources of seeds and seedlings to overcome the problems of distribution;
- Place an extension specialist at each center and insist that the specialist work in the field;
- Prepare the Peace Corps Volunteers for extension work rather than tree nursery work;
- Request the Ministry of Agriculture to assign ten technical assistants to each center to specialize in energy-related activities and give them support in transport, training, and supervision; and,
- Give more attention to establishing off-center demonstrations of whatever the project is trying to promote, such as planting trees among crops, seed sources and small nurseries, and better stoves for schools, small industries, and other users.

2.7 The project should put far more emphasis on the participation of women. For example, the project's stove specialist should be a woman with a background in home economics. The agroforestry aspects of the project should logically be shaped by answers to such questions as:

- To what extent is firewood a constraint upon agricultural production?
- To what extent can trees contribute to the overall farm enterprise?
- To what extent can firewood trees be a source of cash income?

Such questions directly concern the work and welfare of women, and women should become involved in the answers. For example, in urging rural people to plant more trees, have public

officials considered that they may be overloaded with work already? Every scheme for increasing agricultural productivity calls for more work. A shortage of fuel constrains such schemes because (i) women collecting wood cannot be working at increasing agricultural productivity, and (ii) a scarcity of wood means that dung and residues are burned instead of being used to restore fertility to the soil. Therefore, a fuel component must be built into agricultural productivity schemes.

2.8 The administration of the centers must be tightened up with budgets, work plans, job descriptions, accountability for the use of vehicles, clear chains of command, and frequent, regular supervisory visits by the headquarters staff even if extra-project activities are curtailed. For example, a regional cookstove planning conference was held in Nairobi December 5-10 for twenty participants (from ten countries). Participation in such activities by the EDI staff is certain to decrease time available for the day-to-day supervision provided by the GOK/EDI contracts in Section 5B Item 1.

2.9 In the revised plan of work and budget proposed, the project should move away from its present almost exclusive concern with agroforestry toward the other options for producing energy from wood. Particular attention should go to the exploitation, renovation, and improvement of Kenya's 20,070,000 hectares of open semi-arid woodland as a source of renewable energy with consideration to animal husbandry, wildlife, and environment.

2.10 The Evaluation Mission recommends that the project undertake the following studies:

- Charcoal production and marketing and the effect of government policies on these activities;
- The extent to which the yield of pit kilns can be improved; and,
- The extent to which the use of wood can be improved in the kitchen and the appropriate means of doing so.

Appendix I

Itineraries

Messrs. Kernan and Little:

October	17	Depart New York, U.S.A.
"	18	Arrive London, England
"	19	Depart London
"	20	Arrive Nairobi, Kenya
"	25	Depart Nairobi arrive Kisii
"	26	Depart Kisii arrive Kakamega
"	27	Depart Kakamega arrive Eldoret
"	28	Depart Eldoret arrive Nairobi
November	4	Dr. Little depart Nairobi
"	14	Mr. Kernan depart Nairobi
"	15	Arrive Mombasa
"	16	Depart Mombasa arrive Nairobi
December	14	Depart Nairobi

Mr. Evans:

October	17	Leave Eugene, Oregon, U.S.A.
"	18	Arrive London, England
"	19	Leave London
"	20	Arrive Nairobi, Kenya
"	24	Leave Nairobi arrive Kericho
"	25	Leave Kericho arrive Kakamega
"	26	Leave Kakamega arrive Nairobi
"	27	Leave Nairobi arrive Mombasa
"	29	Leave Mombasa arrive Nairobi
November	5	Leave Nairobi arrive Muranga
"	6	Leave Muranga arrive Meru
"	7	Leave Meru arrive Nairobi
"	15	Leave Nairobi



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Appendix III

Principal Contacts

Staff members of USAID/Kenya and REDSO

H. Mike Jones            EDI/Kenya

Amare Getahun            "

Cyrus Ndegwa            "

Maxwell Kinyanjui        "

Peace Corps Volunteers in REDP (8)

David Muturi, Ministry of Energy and Regional Development

S. N. Muturi, Director of Agriculture, Ministry of Agriculture

Andrew Ligale, former Permanent Secretary, Ministry of Energy

Keith Openshaw, Energy Initiatives for Africa

Michael Bess, Energy Initiatives for Africa

Bjorn Lundgren, International Center for Research in Agroforestry

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Humphrey Ngibuimi, Provincial Forestry Officer, Western Province

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Joseph M. Mutie, Assistant Conservator of Forests, Rift Valley Province

Frederick Owino, Department of Forestry, University of Nairobi

John Karuga, Permanent Secretary, Ministry of Energy and Regional  
Development

Lincoln Bailey, Senior Planner, Ministry of Energy and Regional  
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Filemon Torres, Senior Research Scientist, International Council for  
Research in Agroforestry

P. M. Kagani, Senior Assistant Secretary, Ministry of Finance and  
Planning

Appendix IV

Geographic Coverage of Cookstove Evaluation

- MOMBASA:
- \* Mtwapa FTC; Agroforestry Project - jiko training facilities - cement/vermiculite linings, oil barrel kiln for coconut-husk charcoal production
- Visited:
- \* two household users of improved jikos
  - \* two commercial users of improved jikos
  - \* several restaurants cooking on traditional jikos
  - \* CIIC, where training was held
  - \* Jiko-making shed - 15 employees
  - \* Pottery, making clay liners
- NAIROBI:
- \* Kibera - improved jiko production and training workshop
  - \* Kenyatta University - testing facilities; specimen wood and charcoal stoves, prototype developments
  - \* Ngong - Agroforestry Center
  - \* Jamhuri - stove production and training unit
  - \* Shauri Moyo - artisans producing scrapmetal claddings; retail business and manufacture; review of newest innovations and trial models
- NYERI:
- \* FTC; Agroforestry Project, training/production workshop
- MERU:
- \* Meru Hospital; inspected several rejected improved jikos

- KAKAMEGA:
- \* Partnership for Productivity; promotes appropriate technology (AT) in villages
  - \* Ileshi pottery; production of clay liners, experimental all-ceramic wood and charcoal stoves, clay/metal woodstoves, metal jikomaker making bellbottom claddings
  - \* Fudumi Baptist Center for Community Education; demonstration AT farm
  - \* Shamberere School; Rural Education Program, jiko training
- KISUMU:
- \* Diocese of Maseno South; moulded clay/sand stoves and haybox basket cookers
  - \* Women's pottery group; new kiln to produce clay liners
- EMBU:
- \* Traditional agroforestry methods inspected
  - \* Traditional charcoal production method inspected

Also visited shops and markets in Nairobi, Kisumu, Meru, Embu, Kakamega, Nanyuki, Naromoru, Karatina, Muranga, Mombasa.

## Appendix V

### Organizations Visited with Capabilities in Improved Stoves

- ATAC: (Appropriate Technology Advisory Committee)  
Nairobi. Coordinating agency for Kibera project, aiming to distribute 50,000 improved charcoal jikos in low-income Nairobi squatter settlement.
- UNICEF: Has developed Umeme jiko, a charcoal burner with protected pot; they report 1,000 now in use in Kenya. Available at retail shops, made by local artisans. Also experience with Lorena-type stoves rammed in wooden molds.
- GTZ/MAENDELEO YA WANAWAKE: National association of women's groups; developing two-burner wood-fired chimney stoves in Kisii area. GTZ has experience and success with stoves elsewhere in Africa (e.g., Upper Volta).
- KENGO: Coordinating body for about fifty NGOs involved in energy issues in Kenya. Of these, perhaps twenty are in some way involved in stove work. KENGO has great promise as a coordinating body, but could fragment its efforts badly by becoming too deeply involved in projects.

## Appendix VI

### Evaluation Questions

I. What constraints does this project attempt to overcome?

This project attempts to overcome constraints to energy availability caused by inefficient use or non-use of energy resources. Those resources consist of imported petroleum and coal, those exploited in place (such as wind and hydropower), and those originating in bio-mass:

An example of inefficient use is the common all-metal charcoal stove. An example of non-use is animal dung capable of producing bio-gas.

II. What technologies does the project promote to relieve these constraints?

Among the technologies which this project promotes are: (1) that of combining agricultural crops and energy-producing trees on the same unit of land (agroforestry); (2) that of promoting more efficient charcoal stoves; (3) that of identifying and removing industrial and institutional inefficiencies that waste energy, and (4) that of identifying and promoting technologies which allow the use of non-oil fuel (for example, coal and coffee husks).

III. What technologies does the project attempt to replace? Give specific examples.

Most farmers grow mixed single-storey crops. The project proposes to encourage multiple-storey crops so as to make fuller use of a farm's resources.

Most urban households now use all-metal, unlined charcoal stoves. Heat delivery to the cooking vessel doubles with the use of insulating clay liners. The project proposes to replace the all-metal charcoal stoves with stoves having insulating liners.

Kenya manufactures and uses standard automobile tires. The project proposes to encourage the manufacture and use of radial tires capable of bringing about a six percent saving of gasoline.

IV. Why do project planners believe that intended beneficiaries will adopt the proposed technology?

The appearance of agricultural landscapes shows that rural populations have long been aware of the benefits trees have for the farm enterprise. The project proposes to capitalize on that awareness for introducing agroforestry.

Analyses of household budgets have shown that purchased charcoal is an important item of expense. A cheap and efficient version of the familiar charcoal stove carries with it no obvious barrier to acceptance and the advantage of lower costs.

Economic incentives exist for industries and institutions to adopt more efficient energy technologies. If they prove insufficient, the government may eventually enforce such technologies, much as it now enforces certain safety and health measures in industrial establishments.

- V. What characteristics do intended beneficiaries exhibit that have relevance to their adopting the proposed technologies?

The intended beneficiaries of agroforestry are the owners and operators of small farms in the densely populated central, coastal, and western parts of Kenya. They have a tradition of planting trees for shade, boundaries, poles, posts, fodder, and fruit, and have the skills necessary thereto. Agroforestry broadens that tradition, but builds upon a base already existing by rationalizing the choice of species and the spacing.

The principal beneficiaries of the charcoal stove program are the women who cook food and manage the family budget. They

characteristically belong to women's organizations that can be focal points for disseminating improved charcoal stoves.

VI. What adoption rates have this project or previous projects achieved in transferring the proposed technologies?

The agroforestry technique of using a two-storey cropping system has yet to quantify its benefits to the total farm enterprise under Kenyan conditions. Until it has done so, certain farmers will agree to accept research demonstrations, but agroforestry will not become widespread.

The production and use of improved charcoal stoves have risen from zero two years ago when the project began to about 500 manufactured and put into use each month. The beneficiaries are adopting them because of the clear advantage seen in their saving half the charcoal consumed by previous models.

Of the ten audits completed by March 1983, three have shown energy use reductions of 10, 25, and 30 percent, and three have resulted in actions to reduce fuel consumption.



VII. Will the project set in motion forces that will induce further exploration of the constraints and improvements to the technological package proposed to overcome them?

The project's principal means to explore the constraints and improve technologies to overcome them are the six agroforestry centers, including their cookstove components, and the training in the energy conservation program.

The project's intention is to help prepare the counterpart Ministry of Energy and Regional Development for taking them over as the project terminates, and for continuing and expanding their scope. The government has made budgetary and personnel provisions for such continuation and expansion.

VIII. Do private input suppliers have an incentive to examine the constraints addressed by the project and come up with solutions?

The principal private input suppliers to the agroforestry aspects of the project ought to be the operators of businesses that grow and sell seedling trees to landowners for planting. At present, such private tree nurseries produce only a very small part of the 100 million or so seedlings available each year for planting. The seedlings come mostly from public or semipublic non-profit agencies, either free or at subsidized

prices. That circumstance does not offer incentives for private enterprise.

The project will suggest that as agroforestry techniques become widespread as a means to improve the farm enterprise, the selling price of seedlings that such agencies distribute be raised nearer to costs. Since those costs will inevitably be higher than those of private enterprise, the latter will take over the business.

Private makers and retailers of improved charcoal stoves have an economic incentive to solve the constraint of inefficient use of charcoal. The main problems are no longer those of making, selling, and using such stoves, but those of repair, of quality, and of careful use because they are more delicate than the standard type. Competitive market forces should take care of such matters, although the Ministry of Energy has mentioned enforcing a standard of quality.

Lowering costs and avoiding government regulation are incentives for industrial and institutional users of energy to improve their performance. The first incentive is preferable, but works slowly because it requires analysis and usually funding in each case.

- IX. What delivery systems does the project employ to transfer the new technologies to the intended beneficiaries?

The project has established six agroforestry centers to be focal points from which to transfer agroforestry technology to the beneficiaries. It has thus far done so mostly by training agricultural technical assistants and farmers attending general courses in agroforestry. It is now ready to operate outside of such formal training as well, through direct contacts with farms, schools, women's groups, and agencies working with rural people.

At each center the project has or will soon have a charcoal-stove maker who can teach local artisans to make the improved model. Each center is near to a population center that uses charcoal.

The project is working through the structure of the Ministry of Energy and Rural Development and the Kenya Association of Manufacturers to locate and analyze reasonable good opportunities for conserving energy.

- X. What training techniques does the project contemplate using to transfer the technologies?

Four agroforestry centers are on the grounds of Farmers' Training Centers of the Ministry of Agriculture and Livestock

Development, one (Kitui) is with a Better Life Institute, and one (Ngong) has facilities offered by the Forest Department of the Ministry of Environment and Natural Resources. The sub-center is on the grounds of the Matuga Development Center, a training institution. The practice has been to participate in the instruction of agricultural technical assistants and farmers, both men and women. The project further contemplates adding an element of agroforestry to the curriculum of the University of Nairobi's Faculty of Agriculture as well as to Egerton College and the technical schools concerned with agriculture and forestry.

The procedure for stove dissemination has been to train skilled artisans and place them at the centers for transferring their skills to local stove-makers.

As of September 1983, the project had held 17 training courses at the centers, participated in 17 professional conferences, and issued 51 publications on various aspects of energy.