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Somalia Energy Advisor

Final Report

to

THE SOMALI DEMOCRATIC REPUBLIC.

ENERGY INITIATIVES FOR AFRICA,

and

THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

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Martin Wulfe
August 12, 1986
Mogadishu

Acronyms Used in This Report

AFR/TR/SDP	Africa Bureau, Technical Resources, Special Development Projects Office, AID/W.
AID/W	J.S. Agency for International Development, Washington offices.
CDA	Cooperative Development for Africa (donor's group).
CETP	Conventional Energy Training Program (see S&T/EY).
CIPL	Generally refers to the local currency accounts generated by the U.S. Commodity Import Program - PL-480.
DANIDA	Danish International Development.
EIA	Energy Initiatives for Africa, the regional project funding the Somalia Energy Advisory
EIC	Energy Information Center.
ENEE	Ente Nazionale Energia Elettrica, the national electric power utility.
EPC	Energy Policy Committee.
EPU	Energy Planning Unit.
FINNIDA	Finnish International Development.
GTZ	German Technical Assistance.
IDA	International Development Associates (World Bank)
KENGO	Kenya Energy Non-Governmental Organizations.
LPG	Liquefied Petroleum Gas.
NRA	National Range Agency (in the Ministry of Livestock, Forestry, and Range).
NWP	National Woodstove Programme (part of the NRA)
ODA	Overseas Development Administration (UK)
PV	Photovoltaics.
REDSO/[EA]	Regional Economic Development Services Organization of USAID (for East and Southern Africa).
S&T/[EY]	Bureau of Science and Technology (Office of Energy).
TCE	Technical Committee for Energy.
UNDP	United Nations Development Programme.
UNDTCD	United Nations Department for Technical Cooperation for Development.
UNEP	United Nations Environmental Programme.
UNIDO	United Nations Industrial Development Organization.
UNSO	United Nations Sudan-Sahel Organization.
USAID	United States Agency for International Development (in this report, refers to the Mogadishu Mission).
VITA	Volunteers in Technical Assistance.

Somalia Energy Advisor
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1. Introduction

The energy sector in Somalia is of vital importance to continued economic development. Shortages of fuels have resulted in reduced agricultural development (caused by lack of irrigation), water pumping, industrial development (due to lack of fuels and reliable, high quality electric power), and in some cases, to widespread disease. At least one outbreak of cholera can be traced to the shortage of diesel fuel for water pumping, which resulted in the use of contaminated water for human consumption. Increased usage of woodfuels has led to accelerated deforestation, and to rapidly increasing charcoal prices in urban areas and in refugee camps, causing considerable economic hardship among the low income households, and adversely effecting the agricultural resource base.

In response to the increased need for energy sector development, the Government of Somalia requested an energy advisor from USAID in 1983. The purpose of this request was to begin the process of energy planning, so that these shortages could be avoided in the future. It was obvious then, as it is now, that this would have to be a long-term, ongoing activity that would require continuing financial and institutional support, both from the donors and from the Government of Somalia.

To begin this process, the USAID Mission to Mogadishu signed a personal services contract with Martin Wulfe, to become Somalia's first Energy Advisor. This contract has been funded as a subproject of AID's regional Energy Initiatives for Africa project.

The EIA Energy Advisor arrived in Mogadishu in September, 1984. He has reported directly to the Director General, Ministry of National Planning, and undertaken the following tasks:

1. Act as Ministry of National Planning resident energy advisor and ensure the coordination of energy planning with other Somali Government ministries and agencies.
2. Assist the Somali Government in executing the major recommendations of the recent National Energy Assessment.
3. Coordinate the collection of information on energy resources, supply/demand and data analysis, and further design studies, coordinate data gathering efforts and in other ways assist in the establishment of a national energy information system designed to:
 - a. provide access to energy supply/demand data, and
 - b. provide the analytical framework needed to analyze the costs and benefits of alternative energy programs.

4. Provide guidance and support to implementing agencies and ministries in energy project preparation, including feasibility studies, and assist in monitoring and evaluating energy project progress.
5. Assist the Ministry of National Planning in developing energy sector objectives, priorities and strategies for incorporation into a long-term national energy plan.
6. Assist in defining Somali Government short- and long-term manpower training needs in energy planning, management, and technical skills.
7. Assist and advise in defining priority activities needed in alternative energy development with special attention to charcoal and fuelwood production and conservation, wind and solar power.
8. Assist in planning and executing both rural and urban energy surveys as a means of further identifying Somali energy priorities.
9. Assist in planning follow-up activities to such efforts as socio-economic and fuelwood marketing studies supported by AID or other assistance agencies.
10. Provide guidance and assist the Somali Government to gain access to further sources of energy sector assistance, such as the AID Energy Initiatives for Africa Project, AID Bureau of Science and Technology (S&T/EY) programs or other donors, where the Energy Advisor lacks the specific expertise or resources to carry out tasks as defined in this scope of work.

In order to complete these tasks, the Energy Advisor assisted in the establishment of new energy institutions within the Government of Somalia, coordinated efforts among donors, provided access to technical assistance and training, assisted in the preparation of proposals, and collected and analyzed primary data.

The major achievements during this contract period were 1) the establishment of new energy planning institutions, 2) training of Somali professionals, 3) coordination of energy projects, 4) writing of proposals and 5) the completion of short-term technical assistance funded by AID/W for the electric power utility.

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11. Detailed Activities Related to the Scope of Work

A. Act as Ministry of National Planning resident energy advisor and ensure the coordination of energy planning with other Somali Government ministries and agencies.

In early 1985, it was suggested to the AID Mission that the word "ensure" in this item be changed to "assist," since the energy advisor is in no position to ensure coordination.

Due to Government regulations, the Energy Advisor was not permitted to communicate officially with other Government agencies; all inter-agency written communications must be signed by either the Permanent Secretary or the Minister.

The Energy Advisor requested and was provided with office space within the Ministry of Planning, and reported directly to the Director General for Planning. He communicated frequently, on an informal basis, with the Ministry of Minerals and Water Resources, ENEE (the national electric power utility), and the National Range Agency. Proposals, projects, and technical assistance were coordinated with these agencies. All proposals submitted by donors related to the energy sector were passed to the Energy Advisor for comment.

According to the World Bank funded Energy Assessment of 1983, the first step in policy initiatives was to be the establishment of a "National Energy Commission." Since this institution was not in place at the time of the Energy Advisor's arrival, a lower-level institution, the Energy Planning Unit, was first established within the Ministry. The main function of the Energy Planning Unit is the coordination of all activities related to the energy sector in Somalia. The process of coordination includes assistance in writing proposals, and matching proposals with interested donors.

Several months after the formation of the EPU, two additional agencies were formed: the Technical Committee for Energy (TCE), and the Energy Policy Committee (EPC).

The Technical Committee for Energy (TCE)

The TCE consists of representatives from the Foundry and Mechanical Workshop (chairman), the Ministry of National Planning (secretary), the Somali National University, the Ministry of Minerals and Water Resources, the National Range Agency (NRA), the Electric Utility (ENEE), the Ministry of Industry and Commerce, the Cooperatives (fuel division), and the Somali Academy.

The responsibilities of the TCE are to implement projects related to energy conservation and substitution of new sources of energy, disseminate energy information and data, organize workshops, seminars, and training concerned with energy, inform the Energy Policy Committee about the results of research and the status of

the energy sector in the country, monitor energy projects under implementation, conduct research on new sources of energy, set up subcommittees and a permanent secretariat, and participate in international conferences and seminars concerning energy issues. As of this writing, the Technical Committee is organizing a three day seminar on the energy sector in Somalia.

The Energy Policy Committee (EPC)

The EPC consists of the Minister of National Planning (also the Second Vice President of Somalia and chairman of the Committee), the Minister of Finance, the Minister of Minerals and Water resources, the Minister of Industry and Commerce, the Minister of Public Works & Housing, and the Minister of Livestock, Forestry, and Range.

The responsibilities of the EPC are to establish a national energy policy, to lead all agencies involved in energy matters, to accept and approve all major energy development projects, to establish policies including regulations, prices, taxation, subsidies, etc., and to establish rules and regulations for energy administration of the country.

The Energy Policy Committee has met once, in January of 1986. It has sent recommendations to the President, including a key recommendation that the EPU be upgraded to a department. No apparent action has been taken on this recommendation.

B. Assist the Somali Government in executing the major recommendations of the recent National Energy Assessment.

Although the 1981-82 World Bank-funded energy assessment was never formally accepted by the Somali government, its recommendations, including policy initiatives, initiatives to reduce oil imports, electricity sector investment recommendations, and reforestation and traditional fuels recommendations, were used as guidelines in the activities of the Energy Advisor. Reference is made to this assessment throughout this report.

C. Coordinate the collection of information on energy resources, supply/demand and data analysis, and further design studies, coordinate data gathering efforts and in other ways assist in the establishment of a national energy information system designed to:

- a. provide access to energy supply/demand data, and
- b. provide the analytical framework needed to analyze the costs and benefits of alternative energy programs.

In the revised scope of work, this item was changed to exclude parts (a) and (b). Little or no data was available concerning energy supply and demand when the Energy Advisor first arrived.

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With data collection at such an early phase, it was not considered practical to include an "analytical framework." It was considered more appropriate to simply "establish a national energy information system," with the collection of data, reports, and reference materials. These objectives were achieved through the collection of primary and secondary data, and through the establishment of an Energy Information Center (EIC).

Primary data collection efforts focused on three areas of investigation: households, industry, and agriculture. After more than 12 months of attempting to start a nationwide household energy survey, the effort was abandoned. Delays were caused by logistical difficulties, mostly the lack of adequate transportation.

By November of 1985, it was the judgment of the Advisor that the cost of, and insufficient time remaining for the household survey would not justify the limited additional information that it would provide, over the existing data. Due to limited time and resources, the survey would then have only covered limited regions of the country and would not have included sufficient data for analysis of seasonal variations in household fuel-use patterns. The effort was therefore abandoned at that time.

The industrial energy survey included data from 80% of the industries in the Mogadishu area. These data have been computerized and are now available for further analysis. The final report, as requested by the President, has concluded that there is substantial benefit to be derived from the substitution of heavy fuel oil for diesel, in industry and in regional electrification projects. A summary of these data are presented in the appendix.

The agricultural energy survey is complete and the data have been computerized. The purpose of this survey was to undertake a preliminary assessment of the energy intensity of various activities in agriculture, for each crop grown in Somalia. The goal in this exercise has been to assist agricultural planners in estimating the energy requirements of continuing agricultural development. These energy intensity values are given in the appendix.

Secondary data were collected from the National University and the Ministry of Transportation, concerning wind energy. These data included wind speeds and directions, from many locations in Somalia. They have been computerized and are available for further analysis. An example of the average monthly wind speeds is illustrated in the figures in the appendix. For the two examples shown, for Obbia and Mogadishu, the windspeeds remain high for most of the year, except for around April and November. These data suggest that wind energy should be appropriate for both water pumping and electric power generation in these two locations.

Additional secondary data were collected from the transportation sector advisor in the Ministry of National Planning, concerning the use of intercity land transport vehicles. These data are also computerized and are available for further analysis. A summary is presented in the appendix.

Other data, related to petroleum products imported and sold were collected from the National Petroleum Agency. The national electric power utility, ENEE, provided data concerning sales of electric power in Mogadishu. These data are illustrated in the appendix, and clearly show the erratic consumption of both electric power and petroleum over the past four years. The electric power sales include only the energy for which bills were submitted.

The Energy Information Center was established in January 1985 in the Energy Planning Unit. It contains sources of information related to energy in Somalia, as well as general references. This center is computerized to facilitate the search for information. It is possible to search for sources by title, author, or by keywords (such as wind, solar, electricity, industry, conservation, Kenya, etc.).

The subjects covered in the Information Center include forestry, charcoal, firewood, plantations, stoves, petroleum, electricity, power generation, transmission, distribution, feasibility studies, industry, water supply, alternatives, wind, solar, hydropower, agriculture, biogas, geothermal, coal, planning, policy, and references. Additional resources have been requested from AID in Washington, the UNDP, and ODA in the UK.

D. Provide guidance and support to implementing agencies and ministries in energy project preparation, including feasibility studies, and assist in monitoring and evaluating energy project progress.

In the revised scope of work, this item was changed to exclude the mention of feasibility studies. It was not considered practical, given the resource, institutional, and time constraints, to include the preparation of feasibility studies.

When the Energy Advisor arrived in Mogadishu in 1984, there were only two projects underway that were specifically related to the energy sector: a demonstration of the use of wind energy for electric power generation, and the construction of a 15 MW steam turbine. Other projects, including the exploration for natural gas near Afgoi and the CDA forestry projects, were considered parts of other sectors.

The wind energy project, funded by DANIDA and implemented by UNSO, will install its first wind generator in January, 1987. Delays were caused by contractual problems. The 15 MW steam turbine was commissioned in May, 1985.

In the 1986 Annual Development Plan, there were five projects in the energy sector. They included the wind energy utilization project described above, a second 15MW steam turbine for Mogadishu, two projects for the electrification of regional centers, and a small fuelwood plantation project. The next Five Year Development Plan includes nine "core" (high priority, funded, or ongoing) projects in the energy sector, eight additional "supplementary" projects, and ten separate topics for technical assistance. These are discussed in more detail in the appendix.

The Energy Advisor has assisted in the preparation of proposals, for the establishment of an electric power system maintenance facility, for the rehabilitation of the electric power distribution system in Mogadishu, for the continuation of the National Woodstove Programme, and for the continuation of the wind energy measurement study at Somalia National University.

The proposal for an electric power maintenance facility, to be installed at the Gesira power station, has been submitted to the UNDP for funding. The total cost is approximately US\$ 1 million, and will include additional equipment, training, and extensive technical assistance. Funding is expected in 1987, from the OPEC fund and from the United Nations Capital Development Fund.

A proposal has been written for the rehabilitation of the Mogadishu electric power transmission and distribution system. This project is vital for the effective use of power that will be provided by the Bardheere dam, when it is completed in 1995. Funding, to the extent of approximately US\$ 30 million, is expected from either the Italian or Japanese government.

The National Woodstove Programme had been funded by USAID until early in 1986. At present, it is supported solely with local currency from CIPL (Commodity Import Program - PL480), supported by USAID. A proposal was received from UNEP to provide continuing assistance, to the sum of approximately US\$ 1 million, to support the activities of the NWP for a period of four years. The Energy Advisor assisted in the revision of this proposal, and has also assisted in the communications between the NWP and regional sources of assistance, notably the KENGO (Kenya Energy Non-Government Organizations) group in Nairobi, for training and technical assistance.

Until the end of 1985, the Somali National University was engaged in wind speed data collection at eleven different sites. This effort was funded by the Italian government, and was discontinued when the Italian specialist left Somalia in 1985. A proposal has been written and submitted, through the Energy Advisor, to USAID, for local currency funding, for continuation of this effort. USAID has agreed in principle to fund this project as part of the ongoing activities of the Energy Planning Unit, after the departure of the Advisor.

Many other projects that could be considered part of the energy sector, are included in other sectors in the planning process in Somalia. The exploration for natural gas near Agfoi is included in the minerals and mining sector, most of the activities of the CDA forestry project are in the forestry sector, rehabilitation of the refinery, though minor, is part of the industrial sector, and irrigation water pumping using wind and solar pumps are part of the agricultural and water resources sectors.

Unfortunately, the exploration for natural gas ended with negative results. As a consequence, US\$ 7.2 million remained in the IDA credit for this activity. These funds will be used for further exploration for and implementation of geothermal energy technology in the northern regions, as well as efforts to promote Somalia as a favorable site for the exploration for petroleum.

E. Assist the Ministry of National Planning in developing energy sector objectives, priorities and strategies for incorporation into a long-term national energy plan.

In the revised scope of work, this item was changed to include item 7, "defining priorities needed in alternative energy development."

The objectives of the energy sector, as written by the Energy Advisor for the next Five Year Development Plan, are to "reduce dependence on imported fuels, reduce the rate of deforestation, and at the same time assure the delivery of sufficient supplies of energy for continued and accelerated economic development. The plan focuses on expanding the supplies of energy to regional centers, in order to encourage economic growth outside of the capital city."

Activities in this sector are divided among four subsectors: electric power, petroleum, woodfuels, and alternative energy.

E.1 Electric Power

In order to supply sufficient and reliable electric power, adequate equipment, skills, and institutions are required. The national electric power utility, ENEE, is to receive considerable assistance during this plan period, in the forms of new generating, transmission, distribution, and maintenance equipment, training, and institutional development.

In Mogadishu, an additional 15 MW steam turbine generator is to be installed at the Gesira power plant, and the three non-functioning diesel generator sets are to be rehabilitated. Several of the diesel generators at the Centrale plant are also to be refurbished. The transmission and distribution systems are to be rehabilitated, and an expanded maintenance facility is to be installed. ENEE is scheduled to receive substantial technical assistance and training, in order to upgrade its capabilities and

to provide a higher degree of self-sufficiency.

Outside of Mogadishu, at least nine regional centers will receive assistance in the form of new, expanded, or rehabilitated electric power systems: Hargeisa, Berbera, Gardo, Erigavo, Merka, Bosaso, Burao, Kismayo, and Baidoa. The equipment will include generators, transmission and distribution systems, and meters. Improved maintenance will be provided through mobile workshops that will be provided to ENEE in Mogadishu. Some of these areas will also be explored for the potential use of alternative energy for electric power generation.

In February 1986, a team from Bechtel National, Incorporated, visited Mogadishu for the purpose of assessing the institutional needs at ENEE. This study was funded by USAID. Their report was published in May, and included a large number of specific recommendations. These are summarized below.

For the generation system, it was recommended that the diesel engines at Centrale and Gesira be rehabilitated, and that mechanical and electrical spare parts be provided for a two year operating period. Further rehabilitation was recommended at the existing machine shops at Centrale and Gesira stations. For the steam turbine, it was recommended that plant and laboratory chemicals, and the services of an expatriate instrumentation engineer should be provided.

The transmission and distribution systems should be rehabilitated, including the provision of mobile maintenance equipment. The pole manufacturing plant should be improved. Extensive recommendations were made for enhancing the capabilities of the personnel of ENEE, including engineers, technicians, and managers.

In addition to the above, it was recommended that ENEE should establish immediately a planning services section in the planning and projects department which will undertake demand forecasting, system planning, and capital expenditure prediction. Also, it was recommended that the procedures for purchases of foreign made products and for the approval of hard currency expenditures be simplified. Billing computations should be automated, and the time spent in bill preparation should be reduced from 45 to 15 days by means of a two-shift operation. A disconnect policy should be thoroughly defined for delinquent bills.

E.2 Petroleum

The assurance of adequate supplies of petroleum fuels will be addressed through (1) the continued exploration for indigenous reserves, (2) improved functioning of the institutions and markets, and (3) the use of substitutes wherever possible.

The possibility of the existence of oil reserves in Somalia has prompted exploration among oil companies for many years. In order to further encourage this exploration, the Government plans

to compile all of the information gathered to date, for presentation to additional potential firms. With the attractive franchising arrangements offered by the Government, and encouraging the collection of geological data, many firms are expected to respond to this promotional appeal. The possibility of indigenous Somali oil reserves is very promising.

As part of the continuing technical assistance to the Energy Planning Unit under the next phase of this effort (see section IV, the Future of Energy Planning in Somalia), the petroleum subsector as a whole will be studied and evaluated, to determine potential areas for improvement. This study will include the procurement, shipment, storage, domestic transportation, distribution, pricing, and consumption of crude petroleum and products. This study should result in a more efficient subsector, effectively reducing the consumption of petroleum products and the accompanying loss of foreign exchange.

As part of the work completed by the Energy Advisor over the last two years, it was discovered that considerable savings could be derived through the substitution of heavy fuel oil for diesel fuel, in industry and regional electric power generation. This will conserve foreign exchange by reducing the amount of diesel that is imported, since the refinery in Mogadishu produces an excess of heavy fuel oil and insufficient amounts of diesel. At present, the excess heavy fuel oil is exported at a loss, and diesel must be imported to make up for the shortfall.

E.3 Woodfuels

Somalia depends heavily on woodfuels (fuelwood and charcoal) for domestic energy requirements. While surveys have provided some information on household energy consumption, there is no comprehensive household energy data base that includes regional and seasonal variations of energy consumption patterns among households. A nationwide household energy survey is planned for the period of this plan.

Increased concentrations of population have caused serious localized deforestation, resulting in serious environmental damage and rapidly increasing prices. In response to this, the activities during the five year plan will include (1) reforestation, (2) the acceleration of improved stove manufacture and dissemination, and (3) the strengthening of the Forestry Department in the National Range Agency.

Most of the projects concerning reforestation are included in the Forestry sector. This is because most reforestation projects have multiple goals, including shelterbelts, sand dune fixation, amenity plantations, and fruits, as well as energy. Included in the energy sector, however, is the first phase of the Mogadishu-Merka Fuelwood plantation that is expected to produce about 1000 ha of trees specifically for woodfuels.

The National Woodstove Programme has begun the production and marketing of improved wood and charcoal stoves. Although the original USAID-funded project has ended, additional assistance is expected through USAID, UNEP, and regional programs. This assistance will include training for artisans and the staff of the NWP, and a market analysis to help accelerate the dissemination of improved stoves.

In order to accelerate the rate of reforestation to the point where the prices of woodfuels in urban areas remain relatively stable, the capabilities of the Forestry Department must be enhanced. This is a difficult task, and requires the ability to coordinate all efforts. This project is part of the Forestry Sector.

E.4 Alternatives

There are four sources of energy that are available in Somalia that are commonly referred to as "alternatives": solar, wind, micro or mini-hydro, and geothermal. Since they are not now used in Somalia, the use of coal and LPG (liquefied petroleum gas) can also be thought of as alternatives.

The potentials for PV in Somalia are being explored primarily for water pumping. A pilot project will be constructed near Afgoi to assess the technical and economic feasibility of this technology, and several donors are engaging in small subprojects that include the use of PV for water pumping, refrigeration of medical supplies, communications, and other applications.

Projects are planned for the use of wind energy for both water pumping and the generation of electric power. While the first installations are planned for the Mogadishu area, later units will be installed in more remote locations. While wind energy is less expensive to use than PV, it does require considerably more maintenance. Therefore, to use wind energy successfully will require extensive training and an inventory of spare parts.

Mini-hydro is already in use in Somalia, at the Fanole Dam. Due to seasonal and equipment mismatching, much of the electric power generated there is not now in use. The lesson to be learned here is that the use of small-scale hydro power requires careful planning and study before implementation, especially when used on rivers with flows that are seasonally variable.

A small-scale hydro-power plant is planned for construction along the lower Shebelle River, at Balad. This will provide electric power to the town of Balad as well as to the Somaltex textile factory. Additional sites will be explored, along the middle and upper Shebelle, and possibly along the Juba River as well.

It has long been recognized that the northern regions of Somalia have some potential for harnessing geothermal energy. During this five year period, previous studies that were inconclusive will be completed, and if positive results are indicated, a small pilot unit will be installed. This will provide electric power to Berbera and perhaps to the new cement factory. It can also provide refrigeration for fish processing.

LPG is in fact now produced at the refinery in Mogadishu. However, the market for this energy product has not been developed; storage facilities are inadequate and there are very few appliances available locally that are designed for LPG use. A project will be undertaken to address these issues.

Preliminary reports indicate that there are deposits of lignite in Somalia, but the conclusions were inconclusive. Further studies of coal deposits will be undertaken.

A detailed description of the individual projects is included in the appendix of this report.

F. Assist in defining Somali Government short- and long-term manpower training needs in energy planning, management, and technical skills.

Staff members of the EPU and other professionals within the Government of Somalia have received training, in Somalia and overseas. The training needs of the national electric utility have been defined in the Bechtel report.

The Senior Counterpart of the EPU has participated in a two month training course funded by UNIDO, on energy planning in the Philippines, a two-week UNEP course on renewable energy in Nairobi, a study tour to Nairobi, and is expected to leave Mogadishu within the next two years to study for a master's degree overseas. The two other counterparts in the EPU have received local training in computers and English language, and one of them is expected to participate in the energy planning course given at the University of Pennsylvania, next January, funded by the Conventional Energy Training Program (CETP) through the Science and Technology office of AID/W. A government employee on the Bardheere Dam project is now participating in that same training program.

The report funded by USAID and written by Bechtel, "System Rehabilitation Assessment and Management Audit of the Ente Nazionale Energia Elettrica (ENEE), Mogadishu, Somalia," outlines the training and management needs of the national electric utility. It summarizes the manpower training required for generation system, and transmission and distribution system personnel. It also discusses training needs for management.

G. Assist and advise in defining priority activities needed in alternative energy development with special attention to charcoal and fuelwood production and conservation, wind and solar power.

This item was included in section 5 of the revised scope of work. These activities were described in the section E, above.

H. Assist in planning and executing both rural and urban energy surveys as a means of further identifying Somali energy priorities.

The household, industrial, and agricultural energy surveys are described in sections C and E.

I Assist in planning follow-up activities to such efforts as socio-economic and fuelwood marketing studies supported by AID or other assistance agencies.

This item was deleted from the revised scope of work since USAID has removed forestry from its portfolio. However, a fuelwood marketing study is planned for the near future.

J Provide guidance and assist the Somali Government to gain access to further sources of energy sector assistance, such as the AID Energy Initiatives for Africa Project, AID Bureau of Science and Technology (S&T/EY) programs or other donors, where the Energy Advisor lacks the specific expertise or resources to carry out tasks as defined in this scope of work.

The Energy Advisor made use of the resources available to him, mostly from REDSO/Nairobi, the regional office of the Energy Initiatives for Africa project, S&T/EY, and from AFR/TR/SDP. These resources proved to be extremely valuable, having provided technical assistance (to assess the institutional needs of the national electric utility), reports and articles for the Energy Information Center, access to training programs, and project development support.

The availability of these resources was extremely important to the Energy Advisor. The ability to call upon other resources outside of Somalia proved to be vital to the completion of his scope of work.

III. Constraints

The main constraints that limited the completion of the scope of work were institutional and logistical. As a personal services contractor to USAID, the Energy Advisor was unable to rely on substantial back-up from a corporate employer. Since this was the first effort in Somalia to engage in energy planning, there was no institution within the Government of Somalia that had the overall responsibility for energy planning prior to the arrival of the Advisor.

The responsibility for the energy sector in the Government was held by a large number of agencies and ministries. These include the Ministry of Public Works and Housing, the Ministry of Minerals and Water Resources, the Ministry of Livestock, Forestry and Range, the National Range Agency, the national electric utility (ENEE), the National Petroleum Agency, and the fuel distribution cooperatives.

Logistics are a constraint for most development projects in Somalia. For the Energy Advisor, communications and transportation were particularly difficult. No telephone was provided, nor was a reliable, safe project vehicle.

During his first six months at post, the Energy Advisor suggested changes to his scope of work to reflect more realistic expectations, but these suggestions were not conveyed to the Ministry of National Planning from the USAID Mission. Even with these limitations, the Energy Advisor was able to achieve a substantial portion of his original scope of work.

IV. The Future of Energy Planning in Somalia

Over the past two years, the energy advisor, the Energy Planning Unit, the Energy Policy Committee, the Technical Committee for Energy, and the Energy Information Center have begun the task of planning in the energy sector in Somalia. Data have been collected concerning energy consumption in industry and agriculture, a policy statement has been sent to the President for approval, many civil servants have been sent to the United States and elsewhere for training, new projects and technical assistance have been initiated for the electric utility, and assistance has been given to the National Range Agency to respond to a proposal to continue the National Woodstove Programme.

Because the regional EIA project is coming to an end, there will be no funds available for a second energy advisor from this source. Therefore, it is being proposed that the tasks of the Energy Planning Unit will be continued over the coming year with short-term technical assistance from AID/W, the USAID Mission, and the World Bank; local currency support from PL480 accounts, and the provision of a Somali professional by USAID, who will act as a liaison between the EPU and USAID. This will enable the unit to continue and expand its operations, and provide access to resources in USAID in Mogadishu and AID in Washington. These activities, for the year following the departure of the Energy Advisor, are referred to as Phase II.

The specific objectives of Phase II will be to:

1. Expand the capabilities of the Energy Planning Unit. This will involve increased staff and training, more office space and equipment, a telephone, and a project vehicle.
2. Support the Technical Committee for Energy.
3. Support the Energy Information Center. Hard currency is required for the acquisition of additional books, periodicals, reports, and computer software.
6. Continue to promote the development of alternative sources of energy, including solar, wind, hydro, and geothermal.
7. Reduce the overall dependence on imported petroleum fuels through conservation through the encouragement of alternatives and conservation.

The activities under Phase II of this project will include:

1. The continued coordination of energy sector activities by the EPU, which will be expanded by increasing the amount of office space, equipment, and staff.
2. Provision of short-term technical assistance.

3. Provision of long- and short-term training for civil servants in several fields, both in Somalia and abroad:
 - a. Provision of a master's degree for at least one counterpart on the staff of the EPU, in the field of energy policy planning and management.
 - b. Provision of short-term training, as available, in:
 - energy management and audits
 - energy conservation methods
 - the exploitation of new and renewable energy resources
 - general computer training and literacy
4. Acquisition and use of computerized energy planning models for making energy policy recommendations, and the continued analysis of data that were collected under Phase I;
5. Preparation of the future energy chapters of the annual development plans;
6. Identification and development of energy project proposals and implementation, maximizing the use of local human and financial resources;
7. Mass communication through newspapers, radio, and other means, as well as the publication of a monthly energy newsletter (started under Phase I);
8. Holding of workshops, seminars, and short courses in Somalia on subjects such as energy conservation, agroforestry, and alternative sources of energy;
9. Acquisition of additional books, periodicals, and reports for the development of the Energy Information Center;
10. Continuation of the activities of the Energy Policy Committee and the Technical Committee for Energy.

These activities will be supported in part by funds remaining in the first energy advisor's hard currency budget. These will help to pay for short-term technical assistance. Additional support will need to come from AID/W, specifically in the forms of matching funds and training, and from USAID, in the form of local currency. Some support is also being requested from the World Bank, in the form of technical assistance and hard currency.

At the end of Phase II, it is expected that a second energy advisor will arrive in Somalia in September, 1987. This advisor will report directly to the Director General of the Planning Directorate in the Ministry of National Planning, and will undertake the following tasks as a scope of work:

1. Act as Ministry of National Planning resident energy advisor and assist in the coordination of energy planning with other Somali Government ministries and agencies.
2. Assist the Somali Government in executing the major recommendation of the recent energy assessment conducted by UNDP/World Bank.
3. Continue the collection and analysis of primary data concerning, but not limited to, energy consumption in industry, agriculture, transport, and residences.
4. Conduct analyses on the costs and benefits of alternative energy technologies and strategies, including the substitution of heavy fuel oil for diesel, the use of solar, wind, geothermal, hydro, and other technologies.
5. Provide guidance and support to implementing agencies and ministries in energy project preparation and proposal writing.
6. Assist in the collection of energy information in the form of reports, books, articles, and computer software or data, for the expansion of the energy information center.
7. Assist the Ministry of National Planning in the preparation of annual and multi-year development plans and annual economic performance reviews.
8. Provide assistance to the Somali Government in gaining access to donor programs of energy assistance, including training, capital investment, and technical assistance.

V. Recommendations

Energy planning must be a long-term activity, so a long-term commitment must be made by both the Government of Somalia and the donor(s) providing the technical assistance. A two year project, even if well supported, is insufficient to make substantial headway toward the goal of real energy planning. Future efforts should have a longer planning horizon than two years.

Since this is a new sector of concern for Somalia, and one of great economic importance, additional institutional and logistical support are required. The activities of Phase II and the second energy advisor are bound to fail if the Energy Planning Unit is not provided with, at a minimum, a viable project vehicle and a telephone. The second energy advisor should have access to institutional support and several forms of international communications (telex, cable, and telephone).

The most important lesson learned is the need for sufficient institutional support. Without a reliable, consistent advocate, the second energy advisor will be unable to receive technical assistance, equipment, advice, or information in a timely fashion. The second energy advisor must also have detailed, adequate, hard and local currency budgets established before taking the position.

In 1984, USAID sponsored a study on civil service reform in Somalia. At the time, this report was accepted by the Government and embraced as a desirable goal. The reform included increases in Government employees' salaries, merit increases in pay, enhanced career opportunities, and a general reduction in the size of the Government work force. There has been some reduction in the size of the work force and some Government agencies have received salary increases. But until these reforms are implemented in the energy sector, including the Forestry Department of the National Range Agency and ENEE, no real, long-lasting progress will be made in this sector.

Specific recommendations for ENEE were made in the report by Bechtel, funded by USAID. These include some reorganization, rehabilitation, training, and equipment. Unless ENEE improves its bill collection and management processes, and rehabilitates its transmission and distribution systems, the additional generating capacity that will be available from the Bardheere Dam, the second 15 MW steam turbine, and the rehabilitated diesel generators at Gesira and Centrale will not improve the quantity nor quality of the electricity that is delivered to customers in Mogadishu.

According to a recent letter received by the EPU from ENEE, the Government owes ENEE approximately SoSh 273 million in unpaid bills. The Ministry of Finance should increase the electric power budget line items of all Government agencies, institutions, and Ministries, to better enable them to pay for the electricity that they use.

All projects in the energy sector, and especially those involving large capital expenditures, should include the provision of on-site spare parts inventories. It is not rational to construct a 15 MW steam turbine, for example, and expect ENEE to send telexes to Europe every time a bearing wears out. This kind of problem caused several extended blackouts for Mogadishu over the past two years.

In the Energy Planning Unit, the staff should receive additional training in energy planning and other areas. In order to maintain a high level of expertise in the Unit, the team leader should be given the opportunity to earn his master's degree. Other staff members should be provided with short-term training, in energy planning, the use of micro-computers, data collection and analysis techniques, and in English. The Unit must be provided with adequate transportation and communications, as well as expanded office space when available. In addition, the Unit should be upgraded at least to the status of a department within the Planning Directorate in the Ministry of National Planning.

Appendices

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Appendix I

Project Descriptions for the next Five Year Development Plan:

1. Wind Energy Utilization for Electric Power Generation: This project includes the installation of 5 - 50 kW wind turbine generators, in Mogadishu and small, remote villages. Implementation is expected to begin in early 1987.
2. Gesira Power Station Second 15 MW Steam Turbine: This is a second 15 MW steam turbine at Gesira, that will ensure sufficient generating capacity and standby power, allow for maintenance of the first steam turbine and the diesel generator sets without causing power outages in the city. Implementation is expected to begin in late 1987.
3. Rehabilitation of the Mogadishu Electric Power Transmission and Distribution System: This is expected to improve the delivery of electric power in Mogadishu, by upgrading the cables, poles, transformers, and other equipment so that the power used by consumers will be of a more consistent voltage and will experience fewer outages. Implementation is expected to begin in 1988.
4. Kismayo - Baidoa Power Project: This project will provide expanded and improved electric power to the towns of Kismayo and baidoa, including generation, transmission, distribution, and metering. Implementation was begun in 1986.
5. Geothermal Exploration and Implementation: This will continue the preliminary and inconclusive work that was begun several years ago, to both determine the feasibility of using the geothermal resources in the northern regions, and, if feasible, to install an initial generating set to supply the town of Berbera with additional electric power. Implementation is expected to begin in 1987, and is funded by the remaining funds in the IDA credit for natural gas exploration near Afgoi.
6. Merka Mogadishu Fuelwood Plantations: This will create a substantial fuelwood plantation, totalling more than 1000 ha., that will yield fuelwood for the Mogadishu area on a sustained basis. It will also contribute to the strengthening of the Forestry Department in the National Range Agency.
7. Oil Exploration Promotion Project: This will be a review of existing geological and geophysical data in light of recent structural mapping, basin analysis, and other studies. The purpose is to initiate a systematic statistical compilation leading up to a meaningful promotional program for potential oil exploration firms. Implementation is expected to begin in 1987, funded by existing IDA credits.
8. Rehabilitation of regional electricity, Bosaso, Erigavo, and Gardo: This project will rehabilitate existing equipment and install new equipment in the northern towns, designed to produce

a total of 24 gigawatt hours of electricity after completion. Implementation date is not set.

9. Northern Towns Electrification, Hargeisa, Burao, and Berbera: This project will rehabilitate existing equipment and install new equipment in the northern towns, designed to produce a total of 15 gigawatt hours of electricity after completion. Implementation date has not been set.

The Plan also includes the following "supplementary" projects:

10. Balad Micro Hydro: This will be an implementation of the recommendations made in 1982, to construct a 1.2 MW hydro power facility at Balad, to generate electric power for the town of Balad and for the Somaltex plant.

11. Woodstove Programme: This project is designed to disseminate improved efficiency charcoal and wood stoves, in order to reduce the overall rate of deforestation in Somalia.

12. Stove Manufacture: This project will result in the manufacture of stoves that use liquefied petroleum gas (LPG) as a fuel. This potential energy source is now burned off at the refinery because there is no market for it in Somalia.

13. Power Project: This is a modernization and expansion of the electric power system for the town of Merka.

14. Photovoltaic Water Pumping: This project will involve the installation of a 10 kW photovoltaic water pumping unit at Aray-Moog, near Afgoi. It will be used for the collection of accurate data concerning technical and economic performance of PV and will supply the surrounding area with water.

15. Gesira Power Generation Rehabilitation: This is a project to rehabilitate the diesel generator sets at the Gesira power station, thus making use of existing equipment at minimum cost.

16. Fuel Oil Substitution: This will result in the substitution of heavy fuel oil for diesel fuel in selected stationary applications, including the generation of electric power and steam. This is desirable because the Mogadishu refinery produces excess heavy fuel oil, which is exported at a loss, and insufficient amounts of diesel, which must be imported using foreign exchange.

17. Coal Exploration: This will continue the previous efforts that were preliminary and inconclusive.

Technical Assistance Portion of the Plan:

18. Technical Assistance to the Energy Planning Unit: This will permit the Energy Planning Unit in the Ministry of National Planning to continue its activities.

19. Electric Power Maintenance Facility and Training: This will provide training, equipment, and technical assistance at the Gesira power station to improve the maintenance capabilities of the electric power utility.
20. Management Advisory Services and Vocational Training for ENEE: This assistance will strengthen the institutional capabilities of the electric power utility, in terms of its abilities to plan its system, schedule maintenance, forecast loads, and improve its accounting practices.
21. Household Energy Survey: This will enhance the residential energy data base, a vital source of information for policy decision making in the energy sector.
22. Micro-Hydro Exploration: The only areas explored for the potential of micro-hydro power are within 100 km of Mogadishu. This will explore the potentials in the Middle and Upper Shebelle and parts of the Juba valleys.
23. Woodfuel Sector: This assistance will examine the mechanisms for marketing wood stoves so that the improved models may be more widely disseminated using existing channels.
24. Petroleum Subsector: This assistance will explore the means by which petroleum is acquired, transported, distributed, priced, and consumed, so that improvements can be made that will reduce losses and increase subsector efficiency.
25. Energy Conservation: This assistance will include audits of energy consumption in industries, agriculture, institutions, and transportation, in order to identify areas of potential savings and conservation.
26. Energy Policy Planning: This will supplement the assistance described above, for the Energy Planning Unit, and will include short-term assistance that is defined by the EPU as the need arises.
27. Long Term Energy Advisor: This will include the provision of a second long-term energy advisor in the Ministry of National Planning, for a period of up to five years.

Appendix II

Somalia Energy Bibliography

Electric Power:

1. Assessment of the Electricity Transmission and Distribution, Mogadishu. Proposed Rehabilitation Plan and Mission Report. 1985. Engineering and Power Development Consultants, Ltd., Kent, UK (UNDP).
2. Current and Future Status of the Electric Power Sector in Somalia. Dar, Shibu. 1982. Energy/Development International, Setauket, New York. World Bank (IDA).
3. Electricity Power Development Study of 5 Northern Regional Towns, 1980-1995. 1980. Ewbank and Partners, Ltd., Brighton, UK (ODA).
4. Electricity Power Development Study for 3 Regional Towns, 1980-1995. 1980. Ewbank and Partners, Ltd., Brighton, UK (ODA).
5. Electrification of Baidoa and Kismayo. Tender Documents. 1984. FINNIDA.
6. Feasibility Study and project Preparation for the Extension of the Power Supply System in Mogadishu. 1980. Societe Generale Pour l'Industrie, Geneva.
7. Feasibility Study and project Preparation for the Extension of the Power Supply System in Mogadishu. 1983. Societe Generale Poul l'Industrie, Geneva.
8. Feasibility Report for Rehabilitation, Extension, and Modernization of Electric Generation and Distribution Systems in Chisimaio and Badoa. 1980. National Engineering Services (Pakistan), Ltd., Lahore.
9. First Stage Extension of the Mogadishu Power Supply System. 1984. Societe Generale Pour l'Industrie, Geneva.
10. Power Market Study. 1984. ELC Electroconsult, Milan.
11. System Rehabilitation Assessment and Management Audit of ENEE. 1986. Bechtel National, Inc. (USAID).

Forestry and Woodfuels:

12. Charcoal Industry in Somalia: A Techno-Economic Appraisal. Robinson, A.P., and Smith, A.E. 1984. Tropical Development and Research Institute, London.
13. Development of a National Charcoal Industry. 1984. Emrich, Walter (UNIDO).

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14. Forestry Development and Strengthening of the Forestry Department. 1985. UNSO.
15. Forest Sector, Problems and Possible Solutions. Openshaw, K. 1983. Energy/Development International, Setauket, New York. World Bank (IDA).
16. Improved Stoves in Somalia, in VITA News, October, 1985. Nur and Jinah. 1985.
17. Mogadishu-Merka Fuelwood Project. First Phase of 4 Years. 1983. Orgut Consult, AB, Stockholm (UNSO).
18. Non-Sampling Error in Surveys, a Case of Fuelwood Consumption Measurement in Somalia. Smale, Melinda. 1985. Chemonics International, Washington, DC.
19. Production, Marketing, and Consumption of Woodfuels in Mogadishu. Laux, Hubert. 1985. Geographisches Institut der TU, Munich.
20. Self-Help Forestry Project, Project Identification and Preparation Report. McGahuey, Michael. 1985. Checci and Co., Washington DC (UNSO).
21. Survey Results and Recommendations for Survey Procedures. Savoie, M., and Smale, S. 1983.
22. Woodfuel Consumption and Cooking Practices in Selected Sites of Lower Shebelle, Banaadir, and Gedo Regions of Somalia. Smale, Savoie, Shirwa, and Axmed. 1984. VITA.

Petroleum:

23. Petroleum Exploration Promotion Project. 1980. World Bank.

Energy Planning, General:

24. Country Development Strategy Statement, Somalia. 1983. USAID.
25. Energy Sector Strategy Formulation. Fisher, Weston REDSO/EA. 1982. Nairobi.
26. Improved Energy Data Collection and Analysis in Developing Countries. Study Proposal. Burchfield, Shirley. 1984.
27. Mission Report on Energy Planning in the Somali Democratic Republic. Foster, John. 1985. UNDTCD.
28. Mission Report on Somalia. Lovejoy, Derek. 1983. UNDTCD.

29. Proposed Institutional Structure for Energy Planning in Somalia. Palmedo, Philip F. 1982. Energy/Development International, Setauket, New York. World Bank (IDA).
30. Somalia: Issues and Options in the Energy Sector. 1985. World Bank/UNDP.
31. Summary Report of the National Energy Assessment. 1983. Energy/Development International, Setauket, New York. World Bank (IDA).

Alternatives:

32. The Foundry & Mechanical Workshop: Options for Survival. 1985. International Science and Technology Institute (USAID).
33. Report of the Mission to Evaluate Smali Hydro-Power. Severn and Dennis. 1984. UNDTCD.
34. Pilot Center for Research, Application, and Training in the Field of Renewable Energy Resources. No Date or Author.
35. Potential of Renewable Resources in Somalia. 1982. GWK Consulting Engineers.
36. Report of the Fact-Finding Mission in Somalia. Blumel and Kelter. 1981. GTZ.
37. Technical Cooperation (Coal). 1983. GTZ.
38. Technical Observations and Installation of 2 Different Capacity Solar Pumps. Ma'alim and Nur. 1984. Somali Unit for Research on Emergencies and Rural Development and VITA.
39. Water from Wind in Somalia. Annual Report. Pallabazzar. 1984. Somali National University.
40. Water from Wind in Somalia. Investment and Program. Pallabazzar. 1983. Somali National University.
41. Water from Wind in Somalia. Progress Report no. 1. Pallabazzar. 1983. Somali National University.
42. Water Pumping Issues and Options in Somalia. McGowan, Richard. 1985. Associates in Rural Development, Burlington, VT.
43. Water Pumping Windmills for Use with Rehabilitated Water Reservoirs. Meel Van, Joop. 1986. CWD Consultancy Services, Netherlands (FAO).
44. Wind Energy for Electrification in Somalia. Frandsen and Peterson. 1984. RISØ National Lab, Denmark (DANIDA).

Appendix III

Industrial Energy Data

Note: The data presented on the following pages represent a summary of the data collected by the EPU during the recent industrial energy survey. Additional information is available concerning the types and sizes of equipment used and their dates of installation.

At first glance, it appears that many data points are repeated in the table. For example, for the pasta factory, there are two lines that indicate consumption of diesel fuel, both for 1984 and 1985. These numbers represent the consumption of energy by individual pieces of equipment. In other words, the total consumption of diesel in the pasta factory for 1984 was 600,000 liters.

The physical production units are given in tons, except where noted as being in numbers of cases.

Industry		FUEL USED					PRODUCTION			
I Code	Name	I	Year	Code	Descrip	Quant	I	Period	Ton	000 SO. SHI
I311-2	Pasta	I	1984	1 000	1 diesel	555	I	1984	12610	150015
I		I	1985	1 000	1 diesel	416	I	11/85-9/85	7942	104148
I		I	1984		000 kwhr	1611	I	Proj '86	21600	427700
I		I	1985		000 kwhr	1813	I			
I		I	1984	1 000	1 diesel	45	I			
I		I	1985	1 000	1 diesel	34	I			
I		I	1984	2 000	1 gasoline	48	I			
I		I	1985	2 000	1 gasoline	36	I			
I311-2	Ed. Oils	I	1984	3 000	1 F. oil	1	I	1984	0	0
I		I	1985	3 000	1 F. oil	0	I			
I		I	1984		000 kwhr	29	I			
I		I	1985		000 kwhr	5	I			
I		I	1984	1 000	1 diesel	4	I			
I		I	1985	1 000	1 diesel	1	I			
I		I	1984	2 000	1 gasoline	3	I			
I		I	1985	2 000	1 gasoline	1	I			
I311-2	Grn Mill	I	1984		000 kwhr	1	I	1984	342	1262
I		I	1985		000 kwhr	3	I	11/85-9/85	173	1466
I		I	1984	1 000	1 diesel	19	I			
I		I	1985	1 000	1 diesel	7	I			
I		I	1984	2 000	1 gasoline	19	I			
I		I	1985	2 000	1 gasoline	7	I			
I313	Ice Mfg	I	1984	1 000	1 diesel	14	I	1984	375	469
I		I	1985	1 000	1 diesel	10	I	11/85-9/85	281	352
I		I	1984		000 kwhr	100	I			
I		I	1985		000 kwhr	47	I			
I		I	1984	1 000	1 diesel	3	I			
I		I	1985	1 000	1 diesel	2	I			
I		I	1984	2 000	1 gasoline	5	I			
I		I	1985	2 000	1 gasoline	3	I			
I313	Coca Cola	I	1984	1 000	1 diesel	38	I	1984	455754	59248
I		I	1984	1 000	1 diesel	180	I	11/85-9/85	227877	79756
I		I	1985	1 000	1 diesel	29	I	(cases)		
I		I	1985	1 000	1 diesel	135	I			
I		I	1984		000 kwhr	287	I			
I		I	1985		000 kwhr	105	I			
I		I	1984	1 000	1 diesel	90	I			
I		I	1985	1 000	1 diesel	68	I			
I		I	1984	2 000	1 gasoline	36	I			
I		I	1985	2 000	1 gasoline	27	I			

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Industry		FUEL USED			PRODUCTION			
I Code	Name	Year	Code	Descrip	Quant	Period	Ton	000 SO. SH
I313	Pepsi	I 1984	1 000	1 diesel	26	1984	78970	8845
		I 1984	1 000	1 diesel	62	11/85-9/85	7328	2111
		I 1985	1 000	1 diesel	20		(cases)	
		I 1985	1 000	1 diesel	47			
		I 1984			000 kuhr	79		
		I 1985			000 kuhr	38		
		I 1984	1 000	1 diesel	6			
		I 1985	1 000	1 diesel	5			
		I 1984	2 000	1 gasoline	9			
		I 1985	2 000	1 gasoline	7			
I323	Tannery	I 1984	3 Ton	Fuel Oil	60	1984		27563
		I 1985	3 Ton	Fuel Oil	40	11/85-9/85		23240
		I 1984		000 kuhr	0			
		I 1985		000 kuhr	1991			
		I 1984	1 000	1 diesel	15			
		I 1985	1 000	1 diesel	11			
		I 1984	2 000	1 gasoline	30			
		I 1985	2 000	1 gasoline	23			
I352	Medicines	I 1984	1 000	1 diesel	1	1984	0	0
		I 1985	1 000	1 diesel	3	11/85-9/85	0	0
		I 1984		000 kuhr	975			
		I 1985		000 kuhr	7			
		I 1984	1 000	1 diesel	6			
		I 1985	1 000	1 diesel	5			
		I 1984	2 000	1 gasoline	6			
I 1985	2 000	1 gasoline	5					
I352	Deterg'ts	I 1984	1 000	1 diesel	3	1984	722	39379
		I 1984	3 000	1 F. Oil	120	11/85-9/85	181	13126
		I 1985	1 000	1 diesel	3			
		I 1985	3 000	1 F. Oil	90			
		I 1984		000 kuhr	171			
		I 1985		000 kuhr	87			
		I 1984	1 000	1 diesel	30			
		I 1985	1 000	1 diesel	23			
		I 1984	2 000	1 gasoline	39			
		I 1985	2 000	1 gasoline	29			
I356	Fibergls	I 1984	1 000	1 diesel	18	1984		20000
		I 1985	1 000	1 diesel	14	11/85-9/85		20300
		I 1984		000 kuhr	112			
		I 1985		000 kuhr	60			
		I 1984	1 000	1 diesel	15			
		I 1985	1 000	1 diesel	11			
		I 1984	2 000	1 gasoline	6			
I 1985	2 000	1 gasoline	5					

W
2

Industry			FUEL USED			PRODUCTION		
I Code	Name	I Year	Code	Descrip	Quant	I Period	Ton	000 SO. SHI
I 381	I Alum Utens	I 1984	8 000	1 Crank C.	3	I 1984	41	12834
I	I	I 1984	8 000	1 Crank C.	3	I 11/85-9/85	8	4868
I	I	I 1985	8 000	1 Crank C.	3	I		
I	I	I 1985	8 000	1 Crank C.	3	I		
I	I	I 1984		000 kwhr	146	I		
I	I	I 1985		000 kwhr	73	I		
I	I	I 1984	1 000	1 diesel	9	I		
I	I	I 1985	1 000	1 diesel	4	I		
I	I	I 1984	2 000	1 gasoline	34	I		
I	I	I 1985	2 000	1 gasoline	10	I		
I 381	I Foundry	I 1984	8 000	1 Crank C.	8	I 1984	139	884291
I	I	I 1984	9 000	Kg Charcoa	333	I 11/85-9/85	?	?
I	I	I 1985	8 000	1 Crank C.	8	I		
I	I	I 1985	9 000	Kg Charcoa	264	I		
I	I	I 1984		000 kwhr	65	I		
I	I	I 1985		000 kwhr	24	I		
I	I	I 1984	1 000	1 diesel	14	I		
I	I	I 1985	1 000	1 diesel	11	I		
I	I	I 1984	2 000	1 gasoline	14	I		
I	I	I 1985	2 000	1 gasoline	11	I		
I 3909	I Cigar.	I 1984	1 000	1 diesel	7	I 1984	253	335305
I	I	I 1984	1 000	1 diesel	7	I 11/85-9/85	156	617443
I	I	I 1984	1 000	1 diesel	7	I		
I	I	I 1984	1 000	1 diesel	7	I		
I	I	I 1985	1 000	1 diesel	7	I		
I	I	I 1985	1 000	1 diesel	7	I		
I	I	I 1985	1 000	1 diesel	7	I		
I	I	I 1985	1 000	1 diesel	7	I		
I	I	I 1984		000 kwhr	210	I		
I	I	I 1985		000 kwhr	219	I		
I	I	I 1984	1 000	1 diesel	6	I		
I	I	I 1985	1 000	1 diesel	9	I		
I	I	I 1984	2 000	1 gasoline	33	I		
I	I	I 1985	2 000	1 gasoline	16	I		
I 381	I Alum Dr&WI	I 1984		000 kwhr	5	I 1984	?	7280
I	I	I 1985		000 kwhr	3	I 11/85-9/85	?	23053
I	I	I 1984	1 000	1 diesel	9	I		
I	I	I 1985	1 000	1 diesel	7	I		
I	I	I 1984	2 000	1 gasoline	15	I		
I	I	I 1985	2 000	1 gasoline	11	I		

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1986 Mozambique Industrial Energy Survey (Page 4 of 4)

Industry		FUEL USED			PRODUCTION			
I Code	Name	I Year	Code	Descrip	Quant	I Period	Ton	000 SO. SHI
I311-2	Slatrhse	I 1984	1 000	l diesel	18	I		
		I 1985	1 000	l diesel	14	I	?	?
		I 1984	1 000	l diesel	44	I		
		I 1985	1 000	l diesel	33	I		
		I 1984	2 000	l gasoline	6	I		
		I 1985	2 000	l gasoline	4	I		
I381	Pvt Fndry	I 1984	9 000	Kg Charcoal	18	I 1984	151	4176
		I 1984	1 000	l diesel	6	I 1/85-9/85	113	3636
		I 1985	9 000	Kg Charcoal	14	I		
		I 1985	9 000	Kg Charcoal	4	I		
		I 1984	2 000	l gasoline	5	I		
		I 1985	2 000	l gasoline	4	I		
		I 1984		000 kuhr	1	I		
		I 1985		000 kuhr	1	I		
I3909	Urea	I 1984	1 000	l Fuel Oil	9460	I 1984	1613	24197
		I 1985	1 000	l Fuel Oil	4550	I 1/85-9/85	1322	48910
		I 1984	1 000	l diesel	5	I		
		I 1985	1 000	l diesel	5	I		
		I 1984	2 000	l gasoline	22	I		
		I 1985	2 000	l gasoline	43	I		
		I 1984	1 000	l Fuel Oil	9385	I		
		I 1985	1 000	l Fuel Oil	4514	I		
I3692	Lime	I 1984	9 000	Mq Charcoal	17	I		
		I 1985	9 000	Mq Charcoal	15	I		
		I 1984	10 000	Mq Firewood	51	I		
		I 1985	10 000	Mq Firewood	67	I		

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Appendix IV

Transportation Data

Note: The figures in this table represent the traffic in both directions, over a twelve hour period on the days indicated. The values of "0" for the number of vehicles loaded for private cars and buses are in fact "Not Applicable." The data were collected by the transportation sector advisor to the Technical Department in the Ministry of National Planning.

1985 Transportation Survey, Middle and Lower Shebelle Regions (Page 1 of 2)

Item	Town 1	Town 2	Date	MOTOR-CYCLE	PRIVATE CAR	TAXI	BUS <26	BUS 26-45	BUS >45	COOP TRUCK	PICK-UP	DONKEY CART	2-AXLE LIGHT	TRUCK HEAVY	3-AXLE TRUCK	TANKER	TRUCK-TRAILER	TOTAL
umber of Veh.	Noga	Afgoi	7-23	47	477	31	86	181	61	150	173	91	123	159	40	28	18	1665
umber of Pass	Noga	Afgoi	7-23	59	1922	98	1387	6018	3255	2154	755	81	581	717	201	65	77	17370
h. Loaded	Noga	Afgoi	7-23	N/A	0	N/A	0	0	0	N/A	29	27	57	89	24	-	12	238
umber of Veh.	Noga	Afgoi	7-24	137	669	46	138	269	83	177	186	106	97	157	23	36	1	2143
umber of Pass	Noga	Afgoi	7-24	223	2275	174	2098	8810	5077	3257	813	108	516	658	103	101	81	24294
h. Loaded	Noga	Afgoi	7-24	N/A	0	N/A	0	0	0	N/A	28	38	43	87	12	-	7	215
umber of Veh.	Noga	Afgoi	7-25	127	682	31	132	251	86	150	234	89	102	179	11	35	45	2154
umber of Pass	Noga	Afgoi	7-25	191	2215	95	1866	8049	4677	2913	1013	91	530	856	51	83	289	22919
h. Loaded	Noga	Afgoi	7-25	N/A	0	N/A	0	0	0	N/A	27	34	45	91	9	-	22	228
umber of Veh.	Noga	Afgoi	7-26	126	1049	65	145	239	82	134	243	59	84	74	19	31	21	2371
umber of Pass	Noga	Afgoi	7-26	214	3591	252	2205	8485	5141	3008	1333	61	603	733	63	46	156	25891
h. Loaded	Noga	Afgoi	7-26	N/A	0	N/A	0	0	0	N/A	21	36	25	31	5	-	7	125
umber of Veh.	Noga	Balad	8-3	0	58	11	4	84	33	72	35	66	27	40	5	8	15	458
umber of Pass	Noga	Balad	8-3	0	165	35	46	3280	2083	1730	99	66	356	554	55	22	117	8608
h. Loaded	Noga	Balad	8-3	N/A	0	N/A	0	0	0	N/A	2	18	10	27	3	-	12	72
umber of Veh.	Noga	Balad	7-21	4	90	8	12	65	22	84	66	64	45	104	3	22	18	607
umber of Pass	Noga	Balad	7-21	7	296	24	99	2567	1362	1476	463	72	693	717	10	57	156	7999
h. Loaded	Noga	Balad	7-21	N/A	0	N/A	0	0	0	N/A	7	17	15	49	0	-	10	98
umber of Veh.	Noga	Balad	7-22	10	105	13	17	60	29	86	93	60	54	96	9	17	17	666
umber of Pass	Noga	Balad	7-22	12	340	55	179	2356	1813	1900	741	64	530	803	56	39	237	9105
h. Loaded	Noga	Balad	7-22	N/A	0	N/A	0	0	0	N/A	6	16	25	56	6	-	15	124
umber of Veh.	Noga	Balad	7-23	11	96	16	7	69	24	89	68	71	39	58	3	12	22	585
umber of Pass	Noga	Balad	7-23	14	313	54	29	2321	1333	1822	528	71	367	528	50	30	280	7740
h. Loaded	Noga	Balad	7-23	N/A	0	N/A	0	0	0	N/A	2	14	21	30	0	-	18	85
umber of Veh.	Noga	Balad	7-24	6	91	6	5	50	19	100	85	58	44	81	5	15	16	581
umber of Pass	Noga	Balad	7-24	12	285	23	36	1943	1198	2149	583	55	610	626	58	38	101	7717
h. Loaded	Noga	Balad	7-24	N/A	0	N/A	0	0	0	N/A	6	9	23	41	1	-	11	91
umber of Veh.	Noga	Balad	8-1	3	66	3	3	76	20	73	58	56	32	57	5	15	16	483
umber of Pass	Noga	Balad	8-1	3	207	11	8	2502	1270	1616	417	57	492	816	75	33	214	7721
h. Loaded	Noga	Balad	8-1	N/A	0	N/A	0	0	0	N/A	6	5	10	33	1	-	11	66
umber of Veh.	Noga	Balad	8-2	3	104	3	4	84	34	81	37	50	43	28	4	8	13	496
umber of Pass	Noga	Balad	8-2	5	416	8	37	3371	1970	2205	174	50	628	356	13	26	161	9420
h. Loaded	Noga	Balad	8-2	N/A	0	N/A	0	0	0	N/A	5	9	19	15	2	-	7	57
umber of Veh.	Noga	Gesira	7-27	1	15	0	0	2	0	0	10	1	61	37	21	2	0	150
umber of Pass	Noga	Gesira	7-27	2	52	0	0	50	0	0	62	1	221	178	60	5	0	631
h. Loaded	Noga	Gesira	7-27	N/A	0	N/A	0	0	0	N/A	2	0	29	22	18	-	0	71
umber of Veh.	Noga	Gesira	7-30	1	57	0	8	11	0	0	20	29	160	156	25	5	3	475
umber of Pass	Noga	Gesira	7-30	2	209	0	65	277	0	0	68	29	615	497	59	15	7	1843
h. Loaded	Noga	Gesira	7-30	N/A	0	N/A	0	0	0	N/A	3	9	79	75	12	-	0	178
umber of Veh.	Noga	Gesira	7-31	2	58	0	7	11	0	0	15	35	149	177	22	7	11	494
umber of Pass	Noga	Gesira	7-31	4	219	0	78	227	0	0	74	37	809	604	49	20	25	2146
h. Loaded	Noga	Gesira	7-31	N/A	0	N/A	0	0	0	N/A	0	10	62	86	11	-	4	173
umber of Veh.	Noga	Gesira	7-26	40	460	13	35	16	2	8	128	27	70	134	11	0	11	955
umber of Pass	Noga	Gesira	7-26	73	1552	47	411	369	76	105	599	28	334	578	22	0	39	4233
h. Loaded	Noga	Gesira	7-26	N/A	0	N/A	0	0	0	N/A	9	2	27	45	4	-	9	96

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Transportation Survey, Middle and Lower Shebelle Regions (Page 2 of 2)

Item	Town 1	Town 2	Date	MOTOR-CYCLE	PRIVATE CAR	TAXI	BUS <26	BUS 26-45	BUS >45	COOP TRUCK	PICK-UP	DONKEY CART	2-AXLE TRUCK LIGHT	TRUCK HEAVY	3-AXLE TRUCK	TANKER	TRUCK-TRAILER	TOTAL
Number of Veh.	Noga	Harsh	7-27	0	11	0	0	0	0	0	1	1	8	40	4	0	1	66
Number of Pass	Noga	Harsh	7-27	0	56	0	0	0	0	0	15	2	224	612	43	0	4	956
Veh. Loaded	Noga	Harsh	7-27	N/A	0	N/A	0	0	0	N/A	0	1	2	16	2	-	1	22
Number of Veh.	Noga	Harsh	7-30	0	3	0	0	0	0	0	0	0	15	13	2	0	0	33
Number of Pass	Noga	Harsh	7-30	0	20	0	0	0	0	0	0	0	138	97	51	0	0	306
Veh. Loaded	Noga	Harsh	7-30	N/A	0	N/A	0	0	0	N/A	0	0	8	7	0	-	0	15
Number of Veh.	Noga	Harsh	7-31	3	2	0	0	0	0	0	2	0	14	27	6	0	0	54
Number of Pass	Noga	Harsh	7-31	4	11	0	0	0	0	0	20	0	79	410	16	0	0	540
Veh. Loaded	Noga	Harsh	7-31	N/A	0	N/A	0	0	0	N/A	0	0	6	9	0	-	0	15
Number of Veh.	Afgoi	U-Wein	8-11	10	77	11	8	20	12	88	95	11	28	44	21	14	21	464
Number of Pass	Afgoi	U-Wein	8-11	20	265	32	36	707	685	1439	727	18	130	518	124	48	273	5022
Veh. Loaded	Afgoi	U-Wein	8-11	N/A	0	N/A	0	0	0	N/A	12	8	7	30	11	-	16	84
Number of Veh.	Afgoi	Shalan	8-11	25	130	7	17	51	35	44	69	108	48	69	1	14	16	634
Number of Pass	Afgoi	Shalan	8-11	32	464	26	275	1947	1995	870	345	120	636	599	7	28	148	7492
Veh. Loaded	Afgoi	Shalan	8-11	N/A	0	N/A	0	0	0	N/A	1	46	13	24	0	-	2	86
Number of Veh.	Afgoi	Shalan	8-12	13	98	10	9	43	27	51	39	60	28	46	6	13	18	461
Number of Pass	Afgoi	Shalan	8-12	15	329	32	83	1641	1732	945	219	75	273	373	92	29	114	5952
Veh. Loaded	Afgoi	Shalan	8-12	N/A	0	N/A	0	0	0	N/A	8	21	12	16	3	-	7	67
Number of Veh.	Afgoi	U-Wein	8-12	20	75	12	6	24	14	79	109	54	30	54	5	15	30	527
Number of Pass	Afgoi	U-Wein	8-12	24	314	32	150	928	830	1137	706	61	266	346	24	41	235	5094
Veh. Loaded	Afgoi	U-Wein	8-12	N/A	0	N/A	0	0	0	N/A	9	27	7	28	3	-	12	86
Number of Veh.	Balad	Jowhar	10-14	6	60	5	4	35	22	41	53	23	30	38	2	8	23	350
Number of Pass	Balad	Jowhar	10-14	8	202	11	55	1529	1185	747	305	22	537	332	25	17	91	5066
Veh. Loaded	Balad	Jowhar	10-14	N/A	0	N/A	0	0	0	N/A	0	9	16	17	1	-	8	51
Number of Veh.	Gesira	Danane	8-10	3	47	0	2	5	1	0	7	0	13	3	0	4	0	85
Number of Pass	Gesira	Danane	8-10	5	185	0	46	204	55	0	44	0	283	13	0	15	0	850
Veh. Loaded	Gesira	Danane	8-10	N/A	0	N/A	0	0	0	N/A	1	0	4	0	0	-	0	5
Number of Veh.	Gesira	Danane	8-9	8	113	1	1	6	0	0	21	0	13	1	3	3	0	170
Number of Pass	Gesira	Danane	8-9	8	348	5	10	112	0	0	69	0	111	25	9	4	0	701
Veh. Loaded	Gesira	Danane	8-9	N/A	0	N/A	0	0	0	N/A	1	0	0	0	0	-	0	1
Number of Veh.	Brava	Jilib	8-21	0	5	1	0	0	0	3	1	0	1	1	1	0	0	13
Number of Pass	Brava	Jilib	8-21	0	17	3	0	0	0	105	3	0	20	25	30	0	0	203
Veh. Loaded	Brava	Jilib	8-21	N/A	0	N/A	0	0	0	N/A	0	0	0	0	0	-	0	0
Number of Veh.	Brava	Golwein	8-21	0	6	0	2	4	1	6	2	0	4	6	1	0	8	40
Number of Pass	Brava	Golwein	8-21	0	14	0	6	152	50	187	12	0	25	40	22	0	144	652
Veh. Loaded	Brava	Golwein	8-21	N/A	0	N/A	0	0	0	N/A	0	0	0	4	0	-	3	7
Number of Veh.	Brava	Sablale	8-21	0	2	0	0	0	0	1	8	1	11	4	0	1	0	28
Number of Pass	Brava	Sablale	8-21	0	9	0	0	0	0	25	77	1	93	113	0	3	0	321
Veh. Loaded	Brava	Sablale	8-21	N/A	0	N/A	0	0	0	N/A	1	1	3	1	0	-	0	6
Number of Veh.	Jilib	Cansuna	8-14	3	91	2	12	20	4	1	26	0	7	93	4	11	0	274
Number of Pass	Jilib	Cansuna	8-14	4	336	8	146	371	97	20	249	0	77	2016	5	29	0	3358
Veh. Loaded	Jilib	Cansuna	8-14	N/A	0	N/A	0	0	0	N/A	3	0	3	12	0	-	0	18
Number of Veh.	Janane	Kishayo	8-18	4	86	33	23	17	4	12	75	7	21	61	7	8	9	367
Number of Pass	Janane	Kishayo	8-18	5	342	109	430	571	198	272	568	9	254	373	24	28	49	3232
Veh. Loaded	Janane	Kishayo	8-18	N/A	0	N/A	0	0	0	N/A	4	4	5	22	0	-	3	38
Number of Veh.	Janane	Kishayo	8-17	0	49	38	10	9	4	11	62	0	23	43	9	9	5	272
Number of Pass	Janane	Kishayo	8-17	0	178	140	147	309	235	141	595	0	187	309	38	26	40	2345
Veh. Loaded	Janane	Kishayo	8-17	N/A	0	N/A	0	0	0	N/A	1	0	11	15	3	-	3	33
Number of Veh.	Janane	Kishayo	8-19	6	51	18	14	6	0	27	141	1	20	38	1	21	25	369
Number of Pass	Janane	Kishayo	8-19	6	145	50	186	100	0	301	865	5	163	183	7	42	76	2129
Veh. Loaded	Janane	Kishayo	8-19	N/A	0	N/A	0	0	0	N/A	4	1	3	6	0	-	17	31

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Distances Between Towns (km)

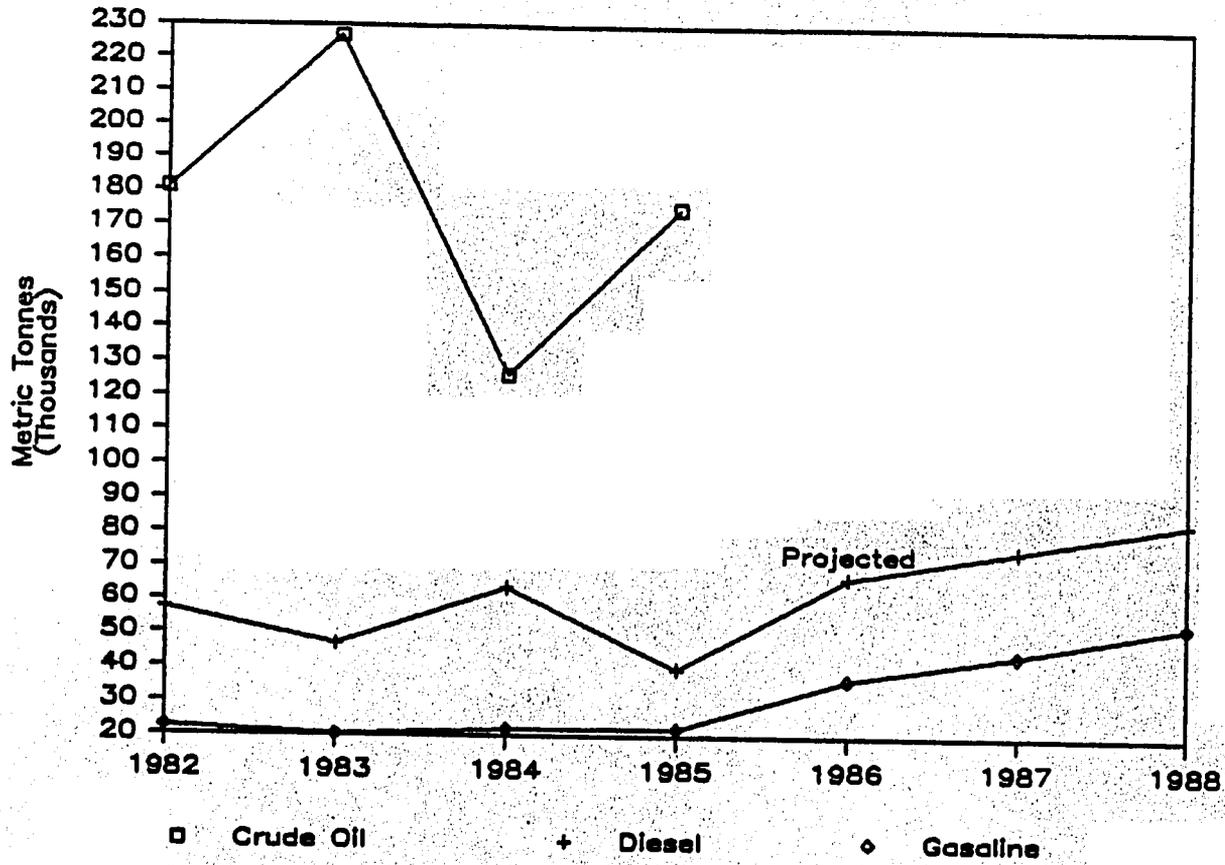
Mogadishu	Afgoi	27
Mogadishu	Balad	37
Mogadishu	Gesira	20
Mogadishu	Warsheikh	63
Afgoi	Wanle-Weyn	64
Afgoi	Shalambod	63
Balad	Gohar	52
Gesira	Danane	20
Brava	Jilib	174
Brava	Galweyn	115
Brava	Sablaale	32
Jilib	Cansuma	36
Jamame	Kismayo	65

Appendix V

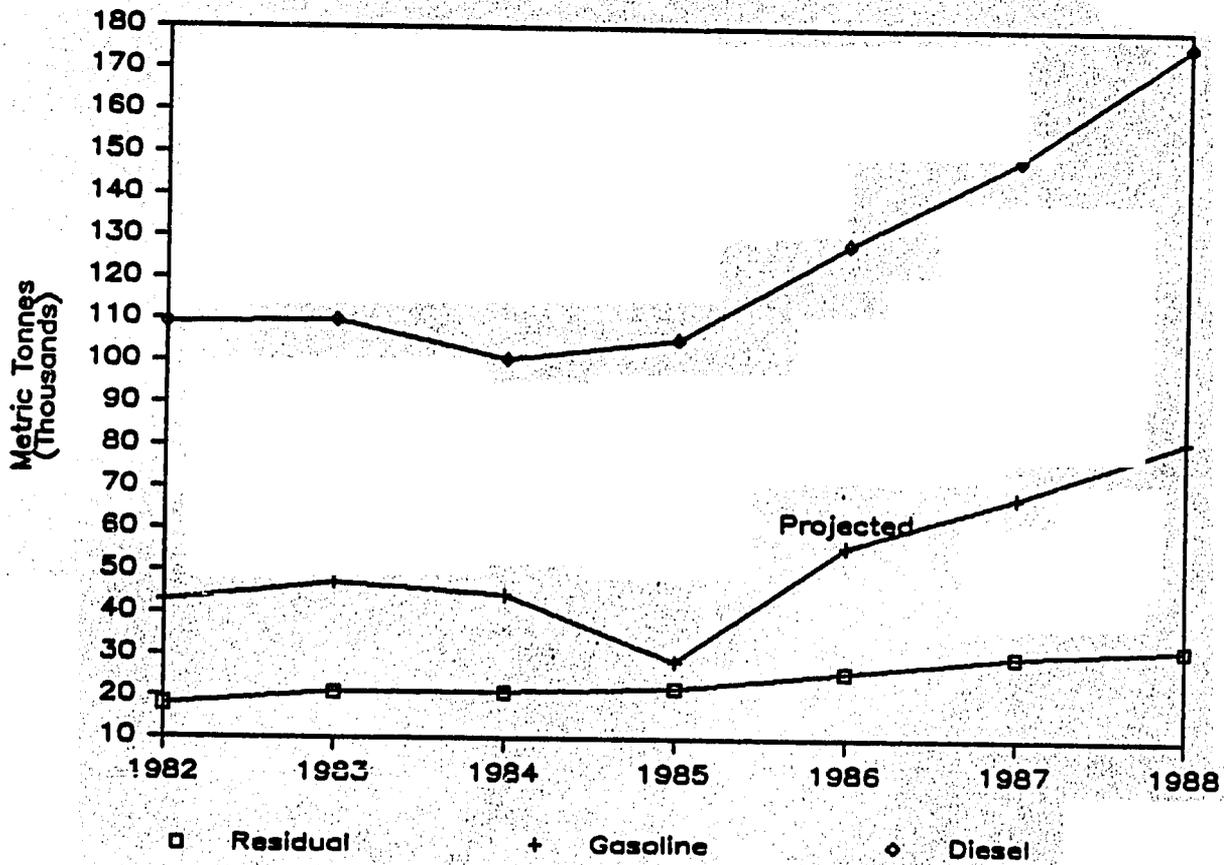
Petroleum Data

Source: NPA

Petroleum Imports



Domestic Petroleum Sales



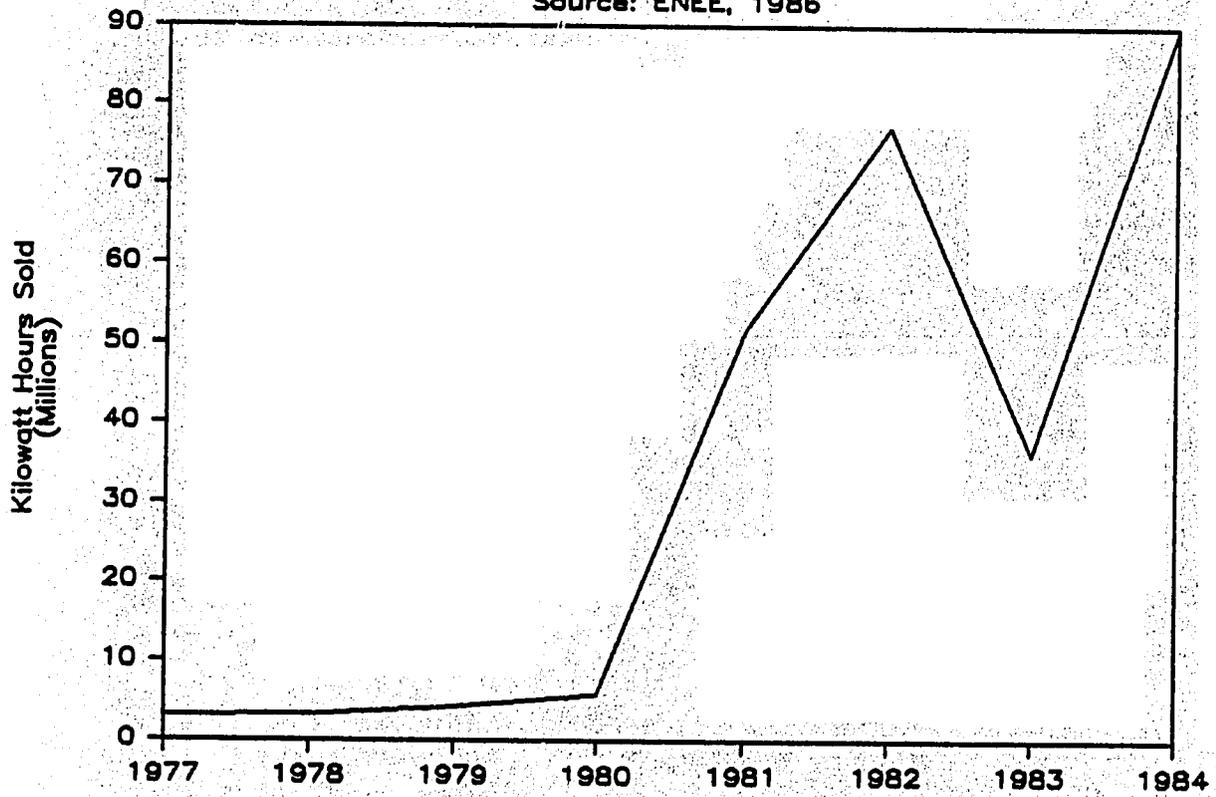
Appendix VI

Electric Power Sales in Mogadishu

Source: ENEE

Electric Power Sales in Mogadishu

Source: ENEE, 1986



Appendix VII

Sample Wind Energy Data

The windspeed data presented graphically on the following pages is derived from information provided by the Ministry of Transportation in Mogadishu. They represent as many as twenty years of data collection, from nine locations: Berbera, Hargeisa, Borama, and Qardo in the north; Beletwene, Galkayo, and Obbia in the region north of Mogadishu; and Mogadishu and Kismayo in the south.

Using wind energy for water pumping requires no particular minimum wind speed. However, the viability of this application depends not only on the wind speed, but also on the depth of the ground water, the quality and quantity of the groundwater, and the correlation of the wind speeds with the demand for water. Even a preliminary analysis of the viability of using wind energy for water pumping would require additional data.

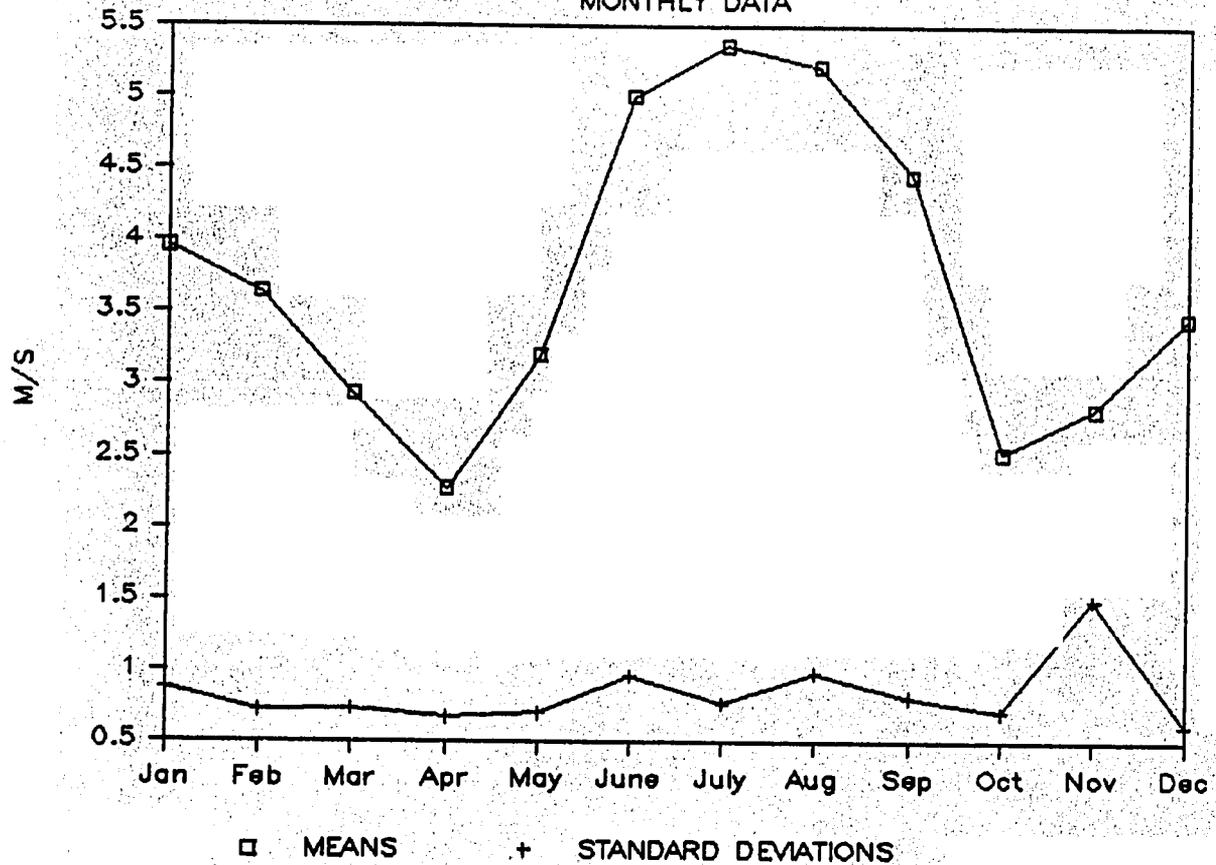
To use wind energy for the generation of electric power, it is generally recommended that the wind speeds should be over 5 meters per second. Therefore, it may be concluded that the windspeeds in Borama are insufficient to generate electric power. Only in Hargeisa and Obbia are the wind speeds high enough year round to justify the use of wind energy.

In Beletwene, the wind speeds are higher than 5 m/s for only two months of the year. In Berbera, the wind speeds are sufficient from March through August, but the high variability of the speeds from year to year during March, April, and May (relative to the average speed) indicates that the high speeds may be unreliable. In Galkayo, the wind speeds at above 5 m/s from May to September only. The wind speeds in Kismayo drop below 5 m/s during two periods of the year, for a total of 2 to 3 months. This is similar to the wind regime in Mogadishu, with two periods of low wind speeds.

It is therefore concluded that wind energy would be best attempted for electric power generation in Hargeisa, Obbia, Mogadishu (because it is centrally located), and perhaps Kismayo, from among the nine locations included in this appendix.

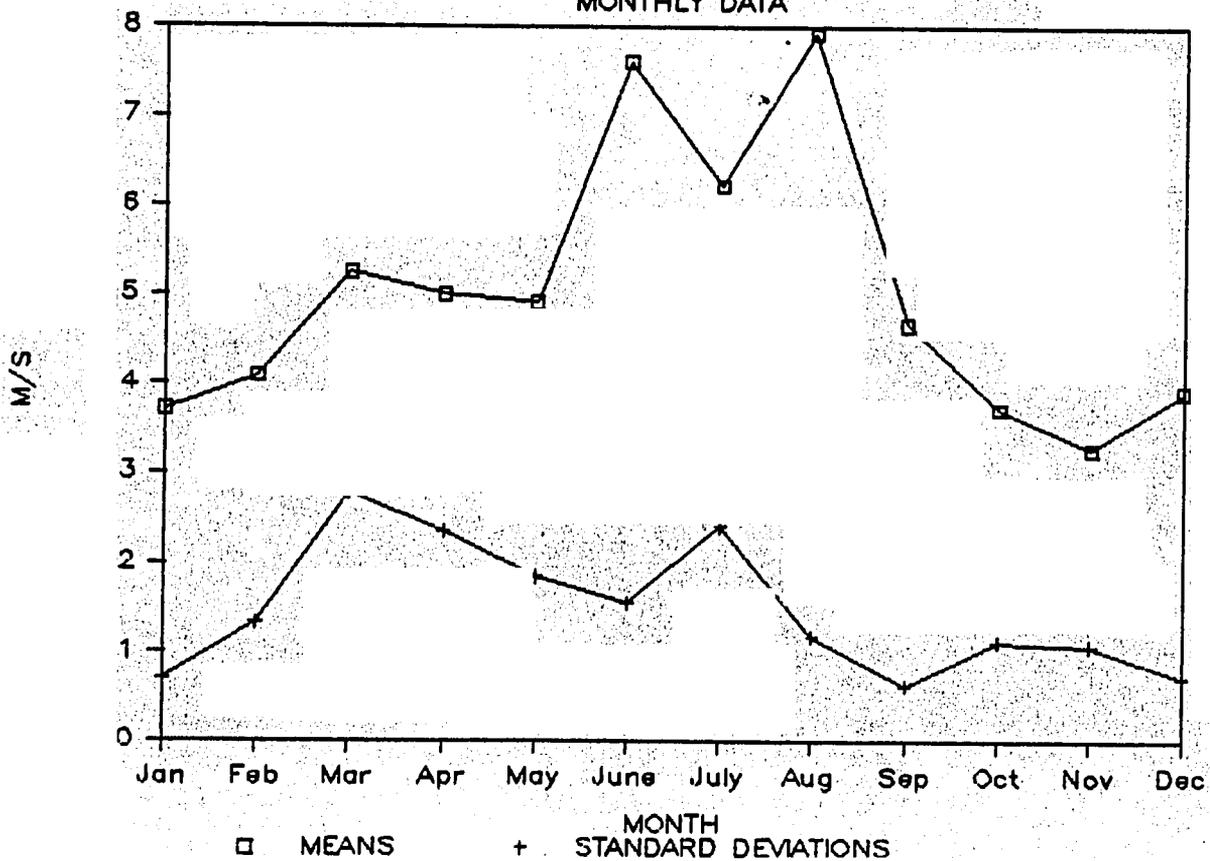
BELETWENE WIND SPEEDS

MONTHLY DATA



BERBERA WIND SPEEDS

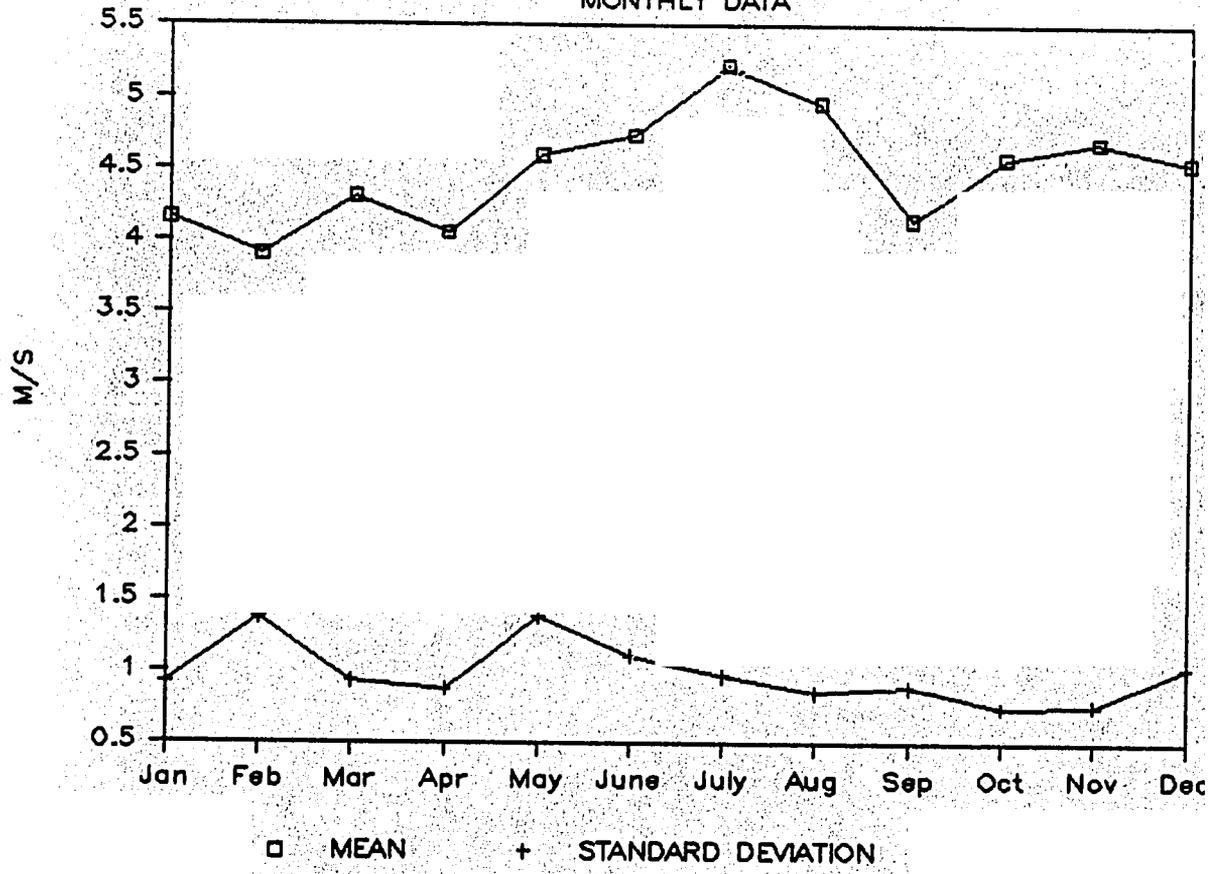
MONTHLY DATA



45

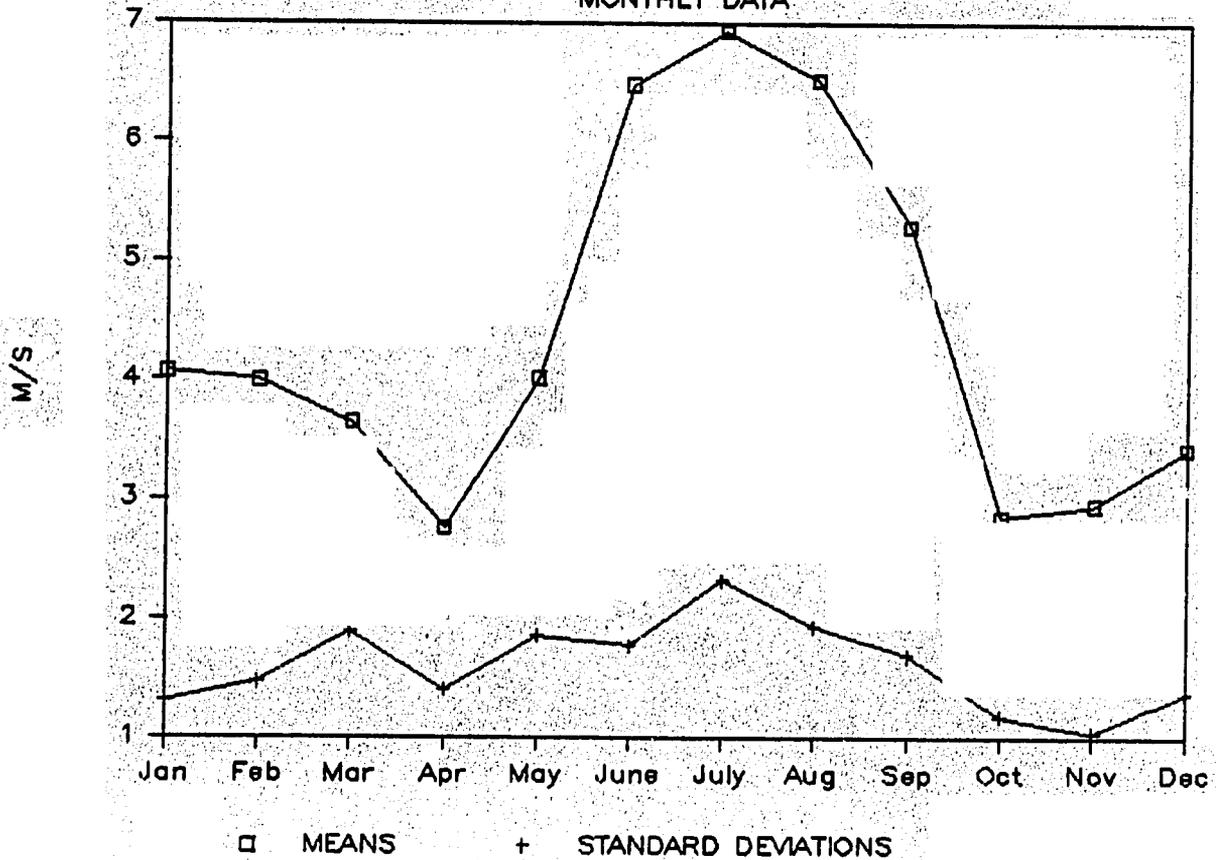
BORAMA WIND SPEEDS

MONTHLY DATA



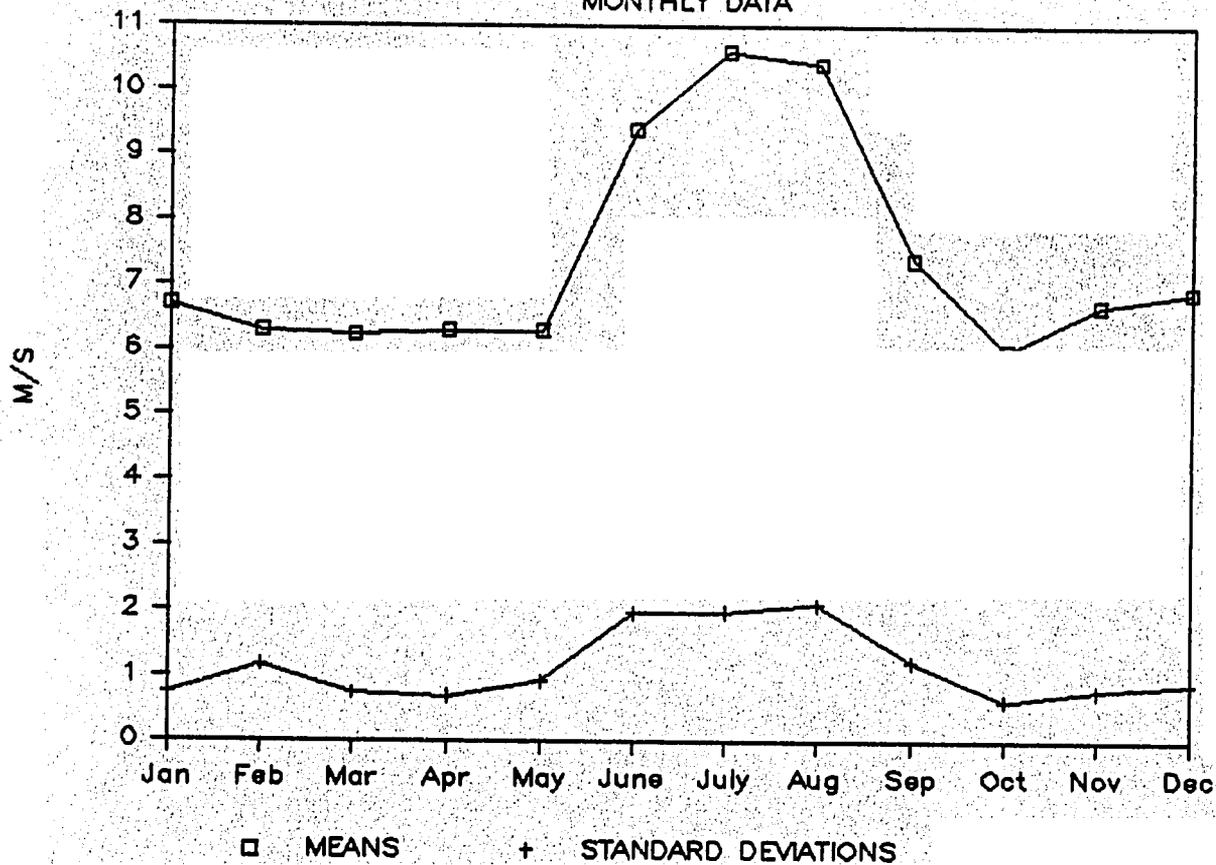
WINDSPEEDS FOR GALKAYO

MONTHLY DATA



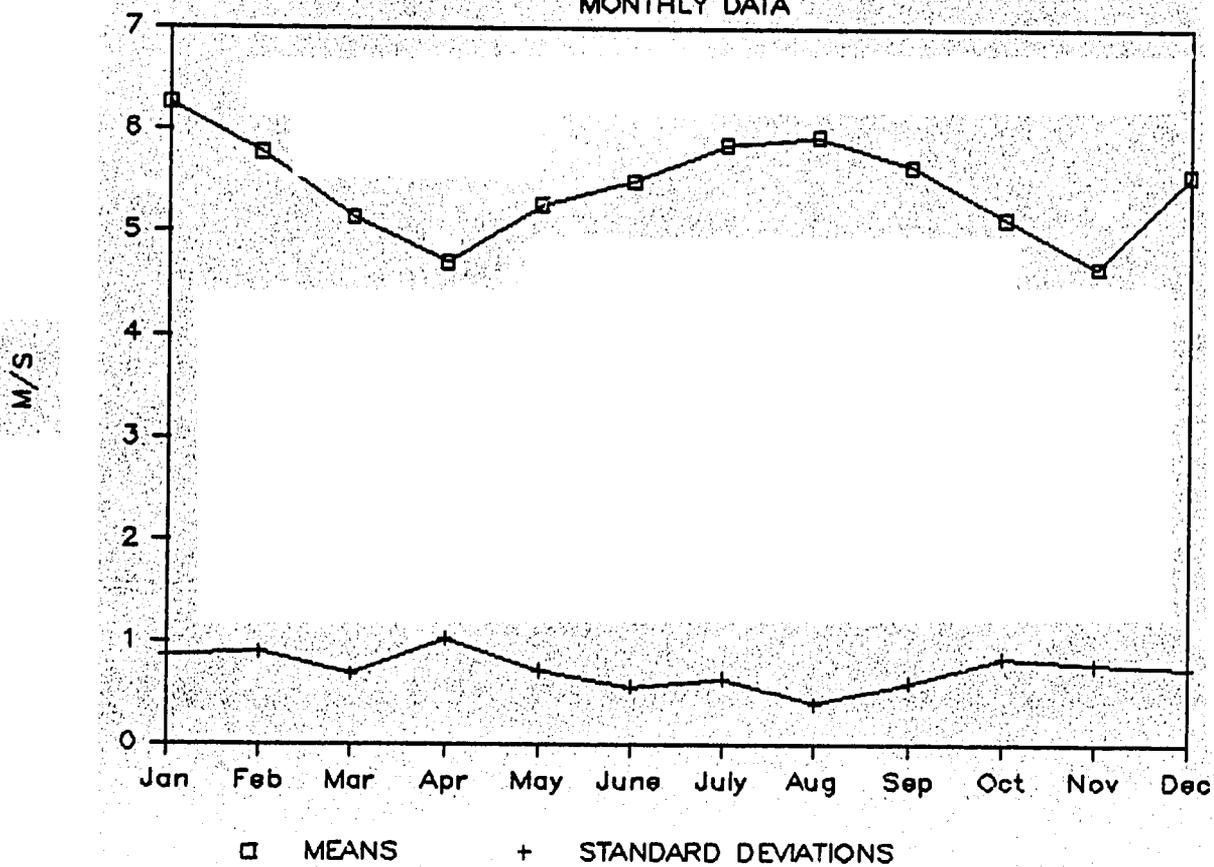
WINDSPEEDS FOR HARGEISA

MONTHLY DATA



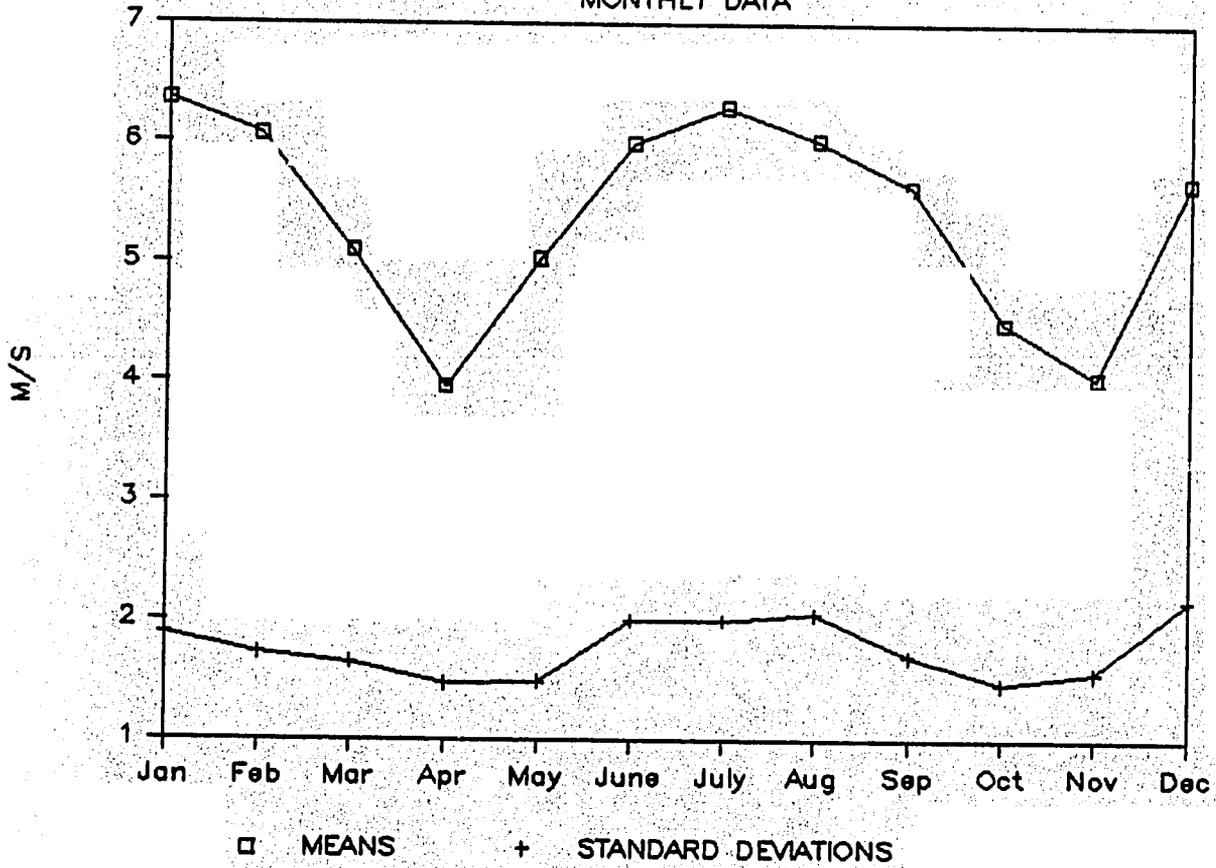
WINDSPEEDS FOR KISMAYO

MONTHLY DATA



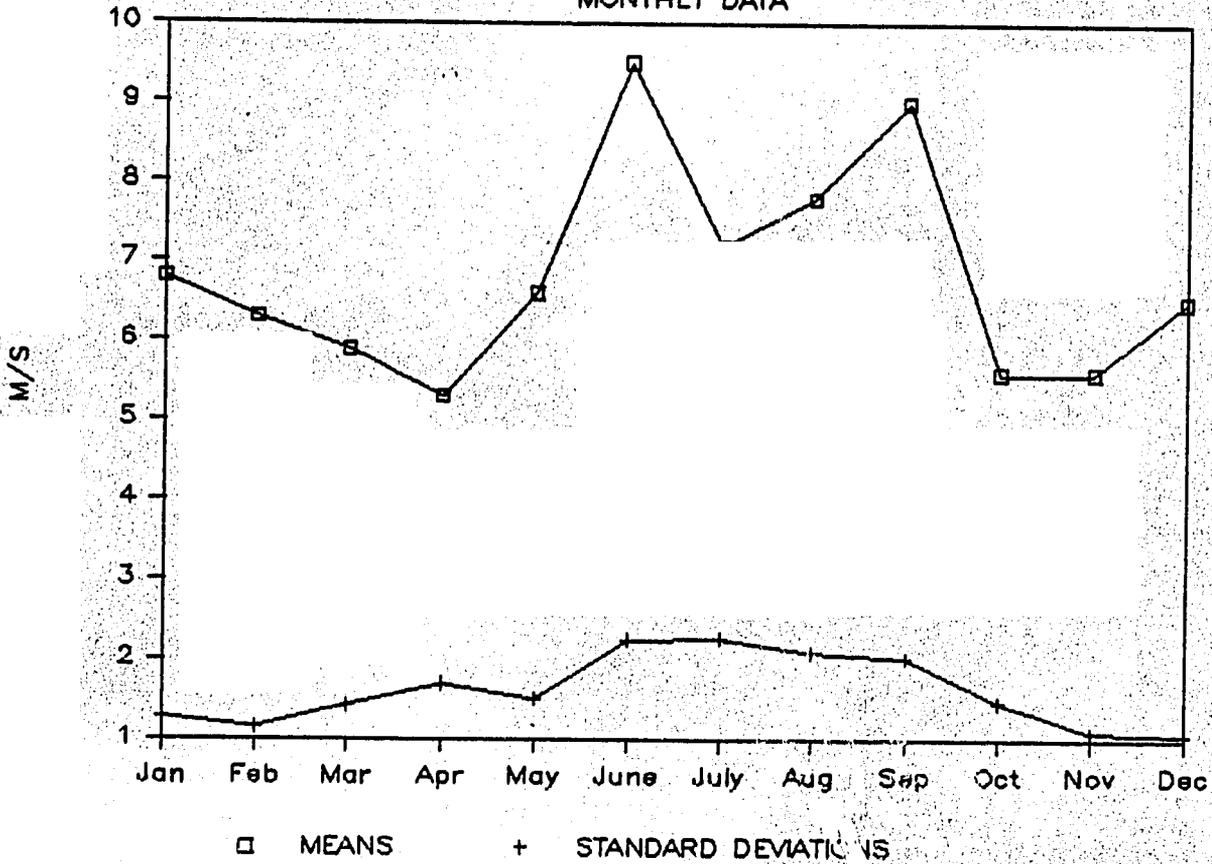
MOGADISHU WINDSPEEDS

MONTHLY DATA



WINDSPEEDS FOR OBBIA

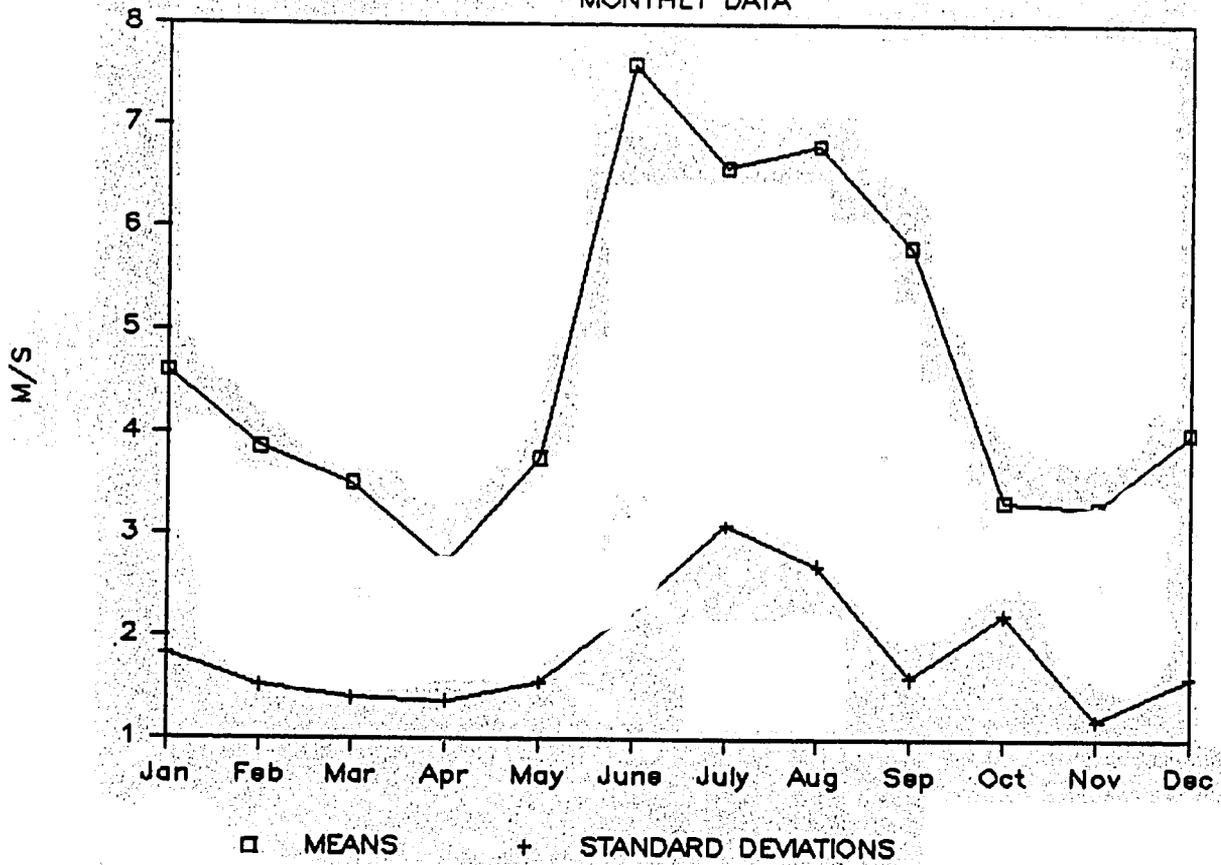
MONTHLY DATA



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QARDO WINDSPEEDS

MONTHLY DATA



Appendix VIII

Agricultural Energy Intensities

These data are meant to be preliminary, and not to imply any statistical significance. They are to be used as indicators on a very basic level, and are designed to assist agricultural development planners in estimating the potential energy requirements of proposed projects. A total of 18 farmers were interviewed in the course of the survey, in Shalabood, Janaale, Qoryoley, Mareerey, Baidoa, Jowhar, Afgoi, Balad, and Kurtunwaareey.

	Tonnes Produced	Hectares
	:=====	
Average per Farm	226	63
Minimum	0.4	1
Maximum	3064	1500

The reader should take note that many farmers in Somalia use manual labor for most of their activities. These activities were not included in these data. Also, much of the mechanized agriculture is performed using hired equipment. The cost of this rental may or may not include the cost of fuel, depending on the arrangement between the farmer and the rentor. In these cases, the farmer may not be aware of the actual amounts of fuel consumed, and the quantities were estimated on the bases of the amount of time the equipment was used.

In the table that follows, each line represents a data point for one farm. Therefore, many points that are repeated. The "new" land is that which had not been previously cultivated, and required clearing.

Crop	New?	Activity	Liters /Tonne	Liters /Ha
	0=No 1=Yes			
banana	0	irrigation	240.00	144.00
beans	0	bunding	1.25	0.50
beans	0	bunding	4.00	2.00
beans	1	bunding	5.00	1.50
beans	0	canalization	1.25	0.50
beans	0	canalization	4.00	2.00
beans	0	furrowing	6.25	2.50
beans	0	furrowing	4.00	2.00
beans	0	harrowing	25.00	10.00
beans	0	harrowing	8.00	4.00
beans	1	harrowing	40.00	12.00
beans	0	irrigation	12.00	6.00
beans	1	landclearing	200.00	60.00
beans	0	plowing	90.00	36.00
beans	0	plowing	24.00	12.00
beans	1	plowing	90.00	27.00
fruits	0	harrowing	1.29	10.00
fruits	0	irrigation	77.42	600.00
maize	0	bunding	0.05	0.10
maize	0	bunding	0.50	0.50
maize	0	bunding	0.62	0.80
maize	1	bunding	0.56	0.50
maize	1	bunding	0.24	0.50
maize	0	canalization	0.20	0.20
maize	0	canalization	0.10	0.20
maize	1	furrowing	0.10	0.21
maize	0	harrowing	11.20	15.00
maize	0	harrowing	12.00	12.00
maize	0	harrowing	6.00	12.00
maize	1	harrowing	7.83	16.00
maize	1	harrowing	11.11	10.00
maize	1	landclearing	22.50	30.00
maize	1	landclearing	80.00	72.00
maize	0	plowing	36.00	36.00
maize	0	plowing	9.00	18.00
maize	0	plowing	15.00	20.00
maize	1	plowing	17.62	36.00
maize	1	plowing	16.67	15.00
rice	0	bunding	0.42	1.50
rice	0	bunding	0.80	2.00
rice	0	clearing	4.00	10.00
rice	0	Combin. Harv.	8.00	20.00
rice	0	harrowing	6.00	15.00
rice	0	harrowing	3.00	10.50
rice	0	harvesting	4.76	16.66
rice	0	irrigation	27.70	97.20
rice	0	planting	6.00	15.00
rice	0	plowing	8.00	28.00
rice	0	plowing	8.00	28.00
rice	0	plowing	8.00	20.00

Crop	New?		Activity	Liters /Tonne	Liters /Ha
	0=No	1=Yes			
sesame	0		bunding	2.27	5.00
sesame	0		bunding	0.20	0.10
sesame	1		bunding	1.25	2.50
sesame	0		canalization	1.25	2.50
sesame	0		canalization	0.20	0.10
sesame	0		furrowing	4.50	10.00
sesame	0		harrowing	47.70	15.00
sesame	0		harrowing	24.00	12.00
sesame	1		harrowing	30.00	10.00
sesame	0		irrigation	120.00	60.00
sesame	1		landclearing	252.00	84.00
sesame	0		leveling	30.00	10.00
sesame	1		leveling	30.00	10.00
sesame	0		plowing	159.00	50.00
sesame	0		plowing	36.00	18.00
sesame	1		plowing	45.00	15.00
sorghum	0		bunding	8.00	0.80
sorghum	0		canalization	8.00	0.80
sorghum	0		combin. harv.	100.00	10.00
sorghum	0		harrowing	122.67	12.27
sorghum	0		irrigation	400.00	40.00
sorghum	1		landclearing	500.00	50.00
sorghum	0		leveling	21.33	2.13
sorghum	0		plowing	128.00	12.80
sorghum	0		plowing	100.00	10.00
sugar cane	0		ditching	1.67	6.00
sugar cane	0		furrowing	4.44	16.00
sugar cane	0		harrowing	4.44	16.00
sugar cane	0		ridging	1.67	6.00
sugar cane	0		plowing	10.00	36.00
vegetables	1		canalization	0.33	0.67
vegetables	1		harrowing	1.00	2.00
vegetables	1		irrigation	166.67	333.33
vegetables	1		leveling	0.33	0.67
vegetables	1		plowing	3.33	6.67
vegetables	1		landclearing	6.00	12.00

Constraints to Production

Constraint	Number of Mentions
Water	6
Equipment	2
Fuel	16
Fertilizer	1
Labor	6
Spare Parts	11
Transport	2
Pests	1

Appendix IX

Charcoal consumption in Mogadishu Households

The following graph is based on data provided to the Energy Planning Unit by the Statistics Department of the Ministry of National Planning. It was collected as part of the household budget survey of 1985, and was analyzed using SPSS/PC. The data reflect the per capita consumption of charcoal, averaged across households of the same size. Households where charcoal is not used, or where data were not provided, are excluded.

Per Capita Daily Charcoal Use

Mogadishu Households, 1985

