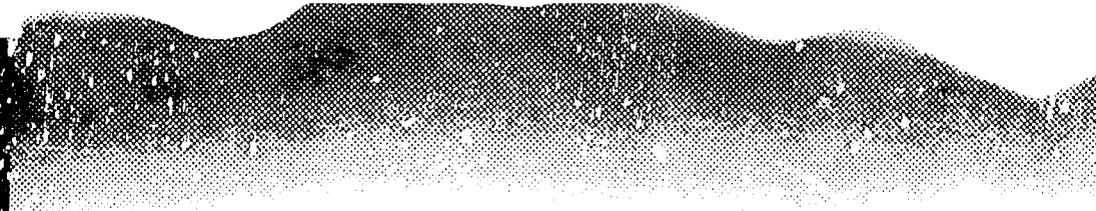


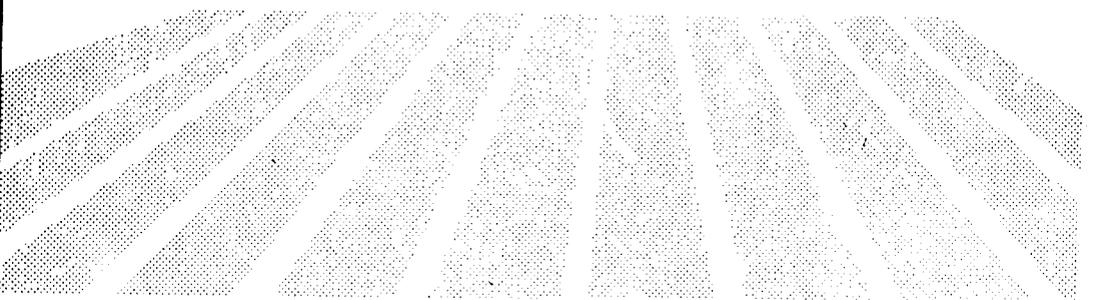
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Ngong/Jamhuri

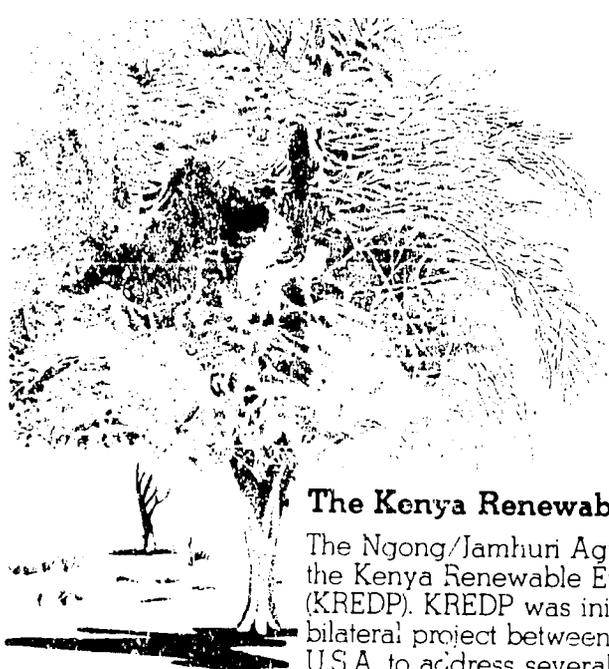
Agroforestry/ Energy Centre

Information Bulletin No. 1



Kenya Renewable Energy Development Project
(KREDP)

March 1985



The Kenya Renewable Energy Development Project

The Ngong/Jamhuri Agroforestry/Energy Centre is part of the Kenya Renewable Energy Development Project (KREDP). KREDP was initiated in October, 1981, as a bilateral project between the Governments of Kenya and U.S.A. to address several critical national energy problems as well as to assist the Government's institutional capacity to solve these energy problems.

To achieve its objectives, the project operates several major components including:

- Agroforestry/Afforestation,
- Cookstoves and charcoal kilns,
- Energy conservation and fuel substitution, and
- Funding of small innovative projects (Energy Development Fund).

The implementation of KREDP is being administered by the Ministry of Energy and Regional Development (MOERD) with close collaboration from the following agencies:

- Ministry of Agriculture and Livestock Development (MOALD),
- Ministry of Environment and Natural Resources (MENR), and
- Kenya Energy Non-Governmental Organisations Association (KENGO).

The physical, institutional and operational basis of KREDP are the six regional Agroforestry/Energy Centres of which Ngong/Jamhuri Agroforestry/Energy Centre, the subject of this bulletin, is one.

KREDP is partially funded by the United States Agency for International Development (USAID). The implementation of the project is being assisted by Energy/Development International (E/DI), a private consulting firm.

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The Ngong/Jamhuri Agroforestry/Energy Center Location

The establishment of the Centre as one of the six regional Agroforestry/Energy Centres was initiated in September, 1982. The Centre is sited in Nairobi in Association with the Ngong Forest Station and the A.S.K. Jamhuri Park (see map on back cover). The areas covered by the centre's programme include Nairobi and all of Kajiado district.

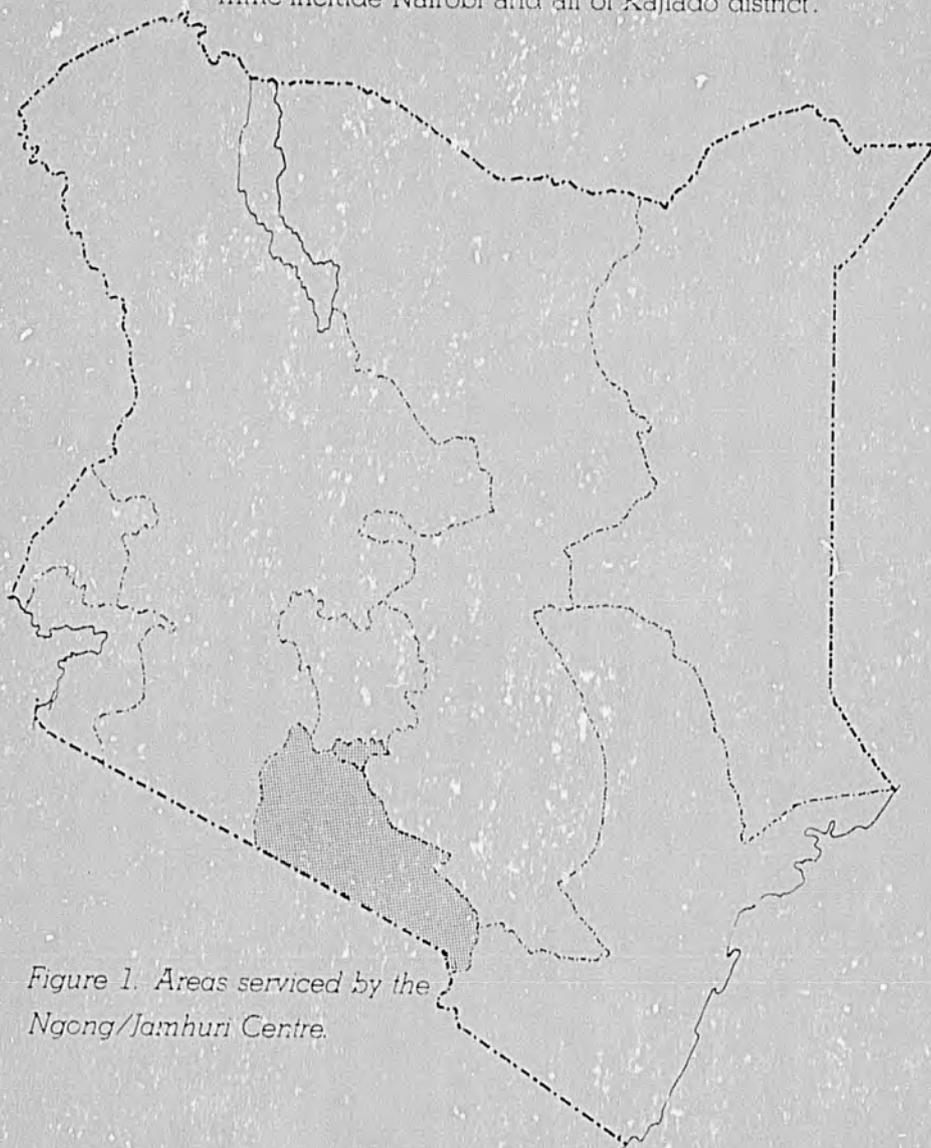
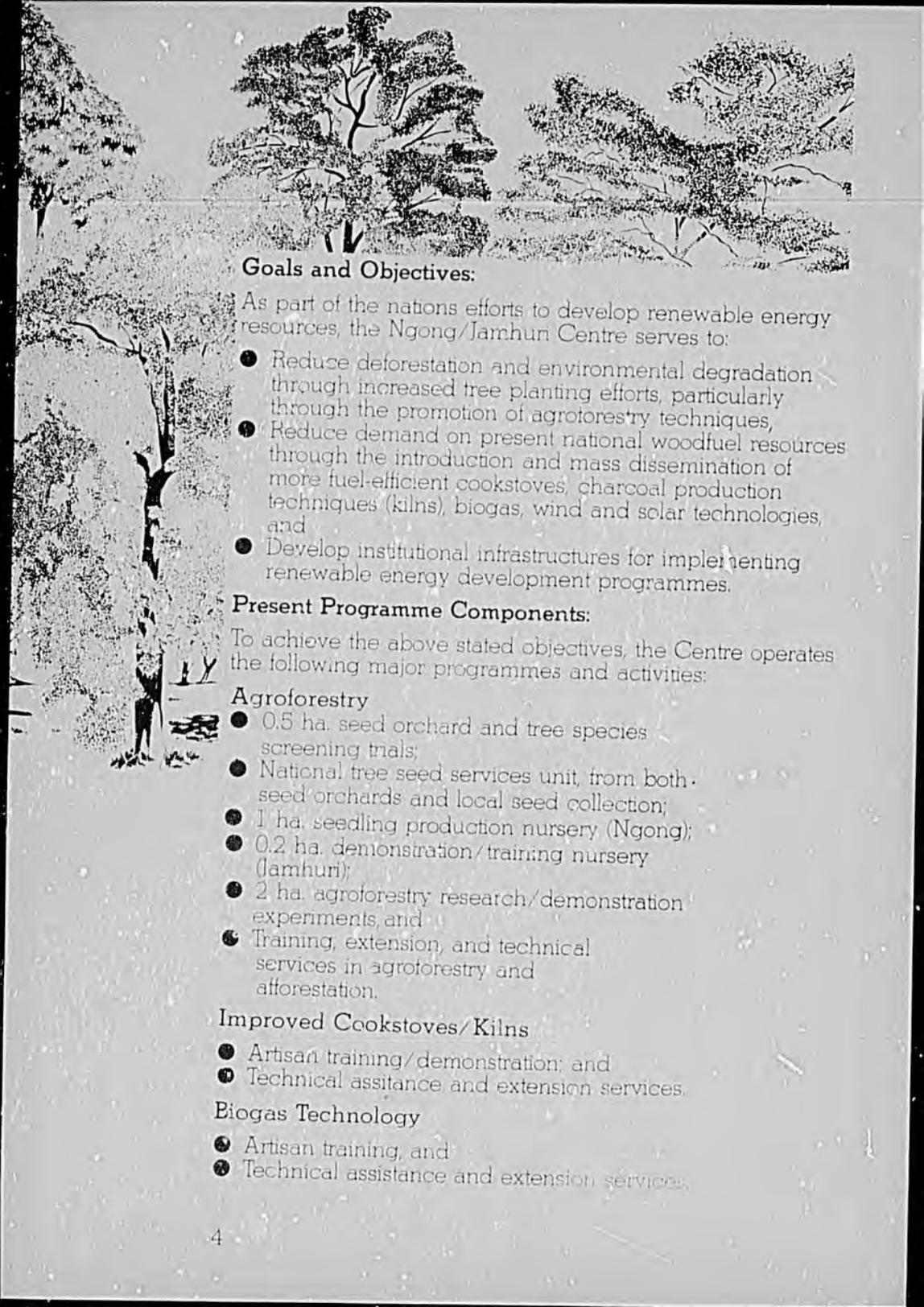


Figure 1. Areas serviced by the
Ngong/Jamhuri Centre.



Goals and Objectives:

As part of the nation's efforts to develop renewable energy resources, the Ngong/Jamhuri Centre serves to:

- Reduce deforestation and environmental degradation through increased tree planting efforts, particularly through the promotion of agroforestry techniques,
- Reduce demand on present national woodfuel resources through the introduction and mass dissemination of more fuel-efficient cookstoves, charcoal production techniques (kilns), biogas, wind and solar technologies, and
- Develop institutional infrastructures for implementing renewable energy development programmes.

Present Programme Components:

To achieve the above stated objectives, the Centre operates the following major programmes and activities:

Agroforestry

- 0.5 ha. seed orchard and tree species screening trials;
- National tree seed services unit, from both seed orchards and local seed collection;
- 1 ha. seedling production nursery (Ngong);
- 0.2 ha. demonstration/training nursery (Jamhuri);
- 2 ha. agroforestry research/demonstration experiments, and
- Training, extension, and technical services in agroforestry and afforestation.

Improved Cookstoves/Kilns

- Artisan training/demonstration; and
- Technical assistance and extension services.

Biogas Technology

- Artisan training, and
- Technical assistance and extension services.

Physical Developments Completed

Because of its location, the Ngong/Jamhuri Centre has enjoyed, and continues to enjoy, close co-operation from several GOK agencies and NGO's including:

- Forest Department (MENR),
- Agricultural Society of Kenya (ASK) - Nairobi,
- Kenya Agricultural Research Institute (KARI, Muguga),
- Appropriate Technology Advisory Committee (ATAC),
- Kenya Energy Non-Governmental Organizations Association (KENGO), and
- G.T.Z. (German) Special Energy Project.



Administration. *KREDP* owes much of its success to the concern and support given by the project administration. In this picture, the Project Officer for *KREDP*, Under Secretary *W.W. Welime* (centre) is inspecting the seed orchard at Jamhuri. *Amare Getahun* (right), Team Leader for the E/DI team implementing the project, explains technical details of the tree species as other *KREDP* staff look on.

Its rapid development has been facilitated greatly by these organisations, especially Forest Department and ASK. The following have been developed to date:

Building/Construction Completed at Ngong Forest Station

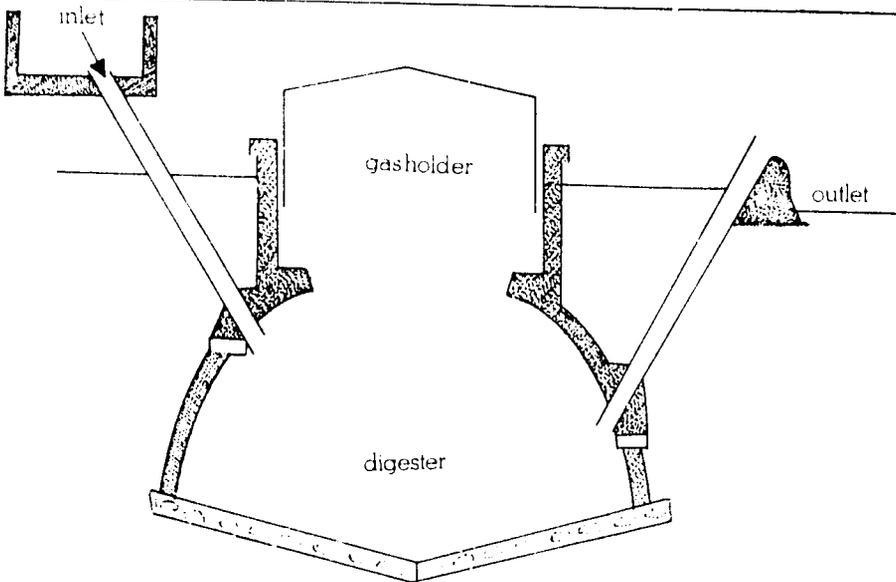
- 1 Store/office,
- 2 Guard houses,
- 1 Pump house,
- 1 Water tower and water tank, and
- 1 Sunken water tank.

Building/Construction Completed at Jamhuri Park

- 1 Store/office,
- 1 Jiko/Biogas showroom,
- 1 Jiko workshop,
- 1 Store warehouse and central seed services unit,
- 1 Biogas and zero grazing unit, and
- 2 Guard houses.

Building/structures at KARI, Muguga

- 1 Cold seed storage unit.



Schematic drawing of a biogas unit. *Biogas units are being built all over Kenya. These units provide a free fuel substituting for charcoal, wood, or petroleum based fuels.*

Agroforestry Programme

The agroforestry sub-programme is comprised of the activity areas described below.

(a) Nurseries

The Centre has established and operate two nurseries with a total production capacity of 1.5 million seedlings per year. The nursery at Ngong is devoted mainly to seedling production, while the nursery at Jamhuri Park is mainly for teaching and demonstration and is thus of smaller size.

Appendix 1 gives the species that are normally produced at the Centre. One can observe that the range of species is large. Thus, the Centre can supply seedlings for many purposes such as fruits, shade, ornamentals, timber, fuelwood, charcoal, bee-keeping (honey), fodder, browse, live fence, and medical uses.



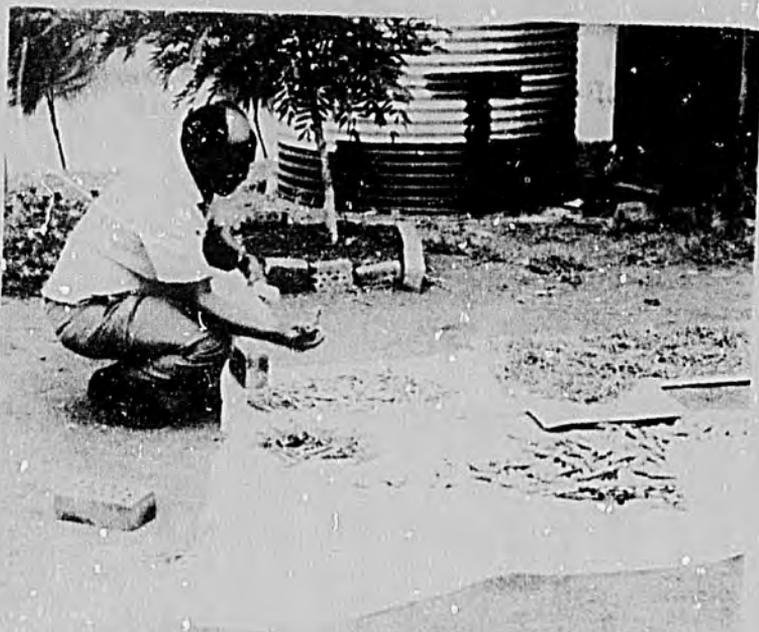
Tree Nursery. *One of the major programmes at the Ngong/Jamhuri Centre is seedling production. This picture shows project staff working in the production nursery at the Ngong Section in the Ngong Forest Station. This nursery has an annual production capacity of over 1.5 million seedlings.*

Organised groups, such as Women's groups, Boys Scouts and public schools can obtain seedlings of selected species free of charge as participants in the Centre's extension and technical services programme. Individual farmers and the public can buy at a low cost.

(b) **Seed and Seed Orchards**

Seed Orchard

The seed orchard at Jamhuri is set up with a variety of different tree species in order initially to screen species by monitoring their performance and growth rates and later to serve as sources of seed. Currently, there are 27 different species each with 35 trees, whose growth rates as well as their effect on food crops and vice versa are being closely monitored (Figure 2). Seeds are already being harvested from several species in the seed orchards (Appendix 2).



Seed Programme. *The Jamhuri Section of the Ngong/Jamhuri Centre houses the Projects Central Seed Services Unit. This Unit coordinates seed collection, processing and storage for the Project. Over 8,000 Kilograms have been collected by the Project to date. Seeds are distributed to nurseries all over Kenya and even outside the country. In this picture, KREDP Senior Agroforester, Cyrus Ndegwa, inspects seeds newly collected from the field.*

Project Impacts and Information Dissemination. *KREDP has attracted much attention from all over Kenya, other countries in Africa and other parts of the world. The Ngong/Jamhuri Centre, because of its location in Nairobi, is frequently a show case for the project as an illustration of the activities at the other Agroforestry/Energy Centres and Sub-centres.*



In this picture, the United States House of Representatives Foreign Relations Committee is being given a tour of the programmes at the Ngong/Jamhuri Centre by Peace Corps Volunteer Bill Macklin.

Central Seed Services

The Ngong/Jamhuri Centre, because of its location, contains the project's Central Seed Services Unit where bulk seed supply is received from all the regional centres. In addition to equipment for drying, scarifying, cleaning, fumigating (innoculating) and bagging, the Unit has seed quality control equipment at Jamhuri and a long term cold storage facility at Muguga (KARI). The Central Seed Services Unit is closely co-ordinated with Forest Department, KARI and KENGO.

(c) Afforestation

Afforestation activities have largely centered around a cooperative effort with the Forest Department in replanting the Ngong Hills. Possible areas of work in the future include expanding the current peri-urban woodfuel plantations of the government (Forest Department), village woodlots and industrial plantations. The Government expects that donor (USAID, GTZ, World Bank, CIDA, EEC, SIDA, Dutch, etc) activity in this area will expand in the future.

(d) Agroforestry Research/Demonstration

Background: Potentials and Constraints of the Region

The upland savannas are a distinct zone ecologically and, to some extent, agriculturally. The region includes Nairobi with its high rate of woodfuel consumption and extends northeast into Kiambu District towards Thika, east into the western corner of Machakos District and south to include much of the northern sections of Kajiado District.

The average temperature is 19°C while the average rainfall is less than 1000mm in most of the region (Appendix 3 gives the rainfall data for the Ngong/Jamhuri Centre for the last 3 years). There are two distinct rainfall seasons: the long rains between March and June and the short rains from October to December. The major soil type is the black cotton soils with underlying murram rock. The vegetation is mostly open grassland with scattered savanna trees and shrubs.

The region has a medium to low agricultural potential, largely due to the edaphic factors and low rainfall. Hence, crop farming is not intense nor significant despite the excellent market opportunities from Nairobi and other nearby urban centres. Livestock production is, however, important.

Nairobi is the largest urban centre in the country and has tremendous demand for woodfuels. The demand for charcoal in Nairobi is high (45% of the consumption in Kenya) and this has led to the heavy exploitation of the woodlands in the Ngong and other surrounding areas resulting in woodfuel importation from as far away as 300 km.

Currently, about half of the fuelwood plantations (approximately 6,000 hectares) in Kenya are situated around Nairobi. Nairobi also serves as the leading centre for tree seedlings distribution to other parts of the Republic; however, the planting of trees specifically for fuelwood is not given adequate attention. Outside of the urban areas, in the upland savanna, trees are naturally scarce and the growing rural population must cope with a severe woodfuel shortage.

The conditions just discussed are sufficient justification for the promotion of agroforestry systems in the region, particularly those systems that enable both fodder and fuelwood production. Quick-growing drought resistant, multipurpose tree varieties (including indigenous species) are encouraged. Due to the semi-nomadic lifestyle of many of the inhabitants outside of the urban centres, initial agroforestry activities have been concentrated around market centres to form a nucleus for future extension work. Near Nairobi, large-scale farmers and investors are being encouraged to grow fuelwood on commercial basis using agroforestry practices.

Description of Agroforestry Research Program

Due to land availability constraints at Jamhuri ASK grounds, a research and demonstration farm of only 2 hectares has been developed. The farm serves as a teaching/demonstration tool as well as to generate biotechnical data which will form the basis for recommendations and technical packages. There are a total of 5 tree species in the agroforestry experiment, namely: *Eucalyptus saligna*, *Calliandra calothyrsus*, *Sesbania grandiflora*, *Grevillea robusta* and *Persea americana*. Figures 3 & 4 show the basic research plot design.

The major tests being conducted and data being collected in the research/demonstration plots include:

1. Soil fertility (both soil chemical and mechanical analysis),
2. Light measurements (radiation available to crops),

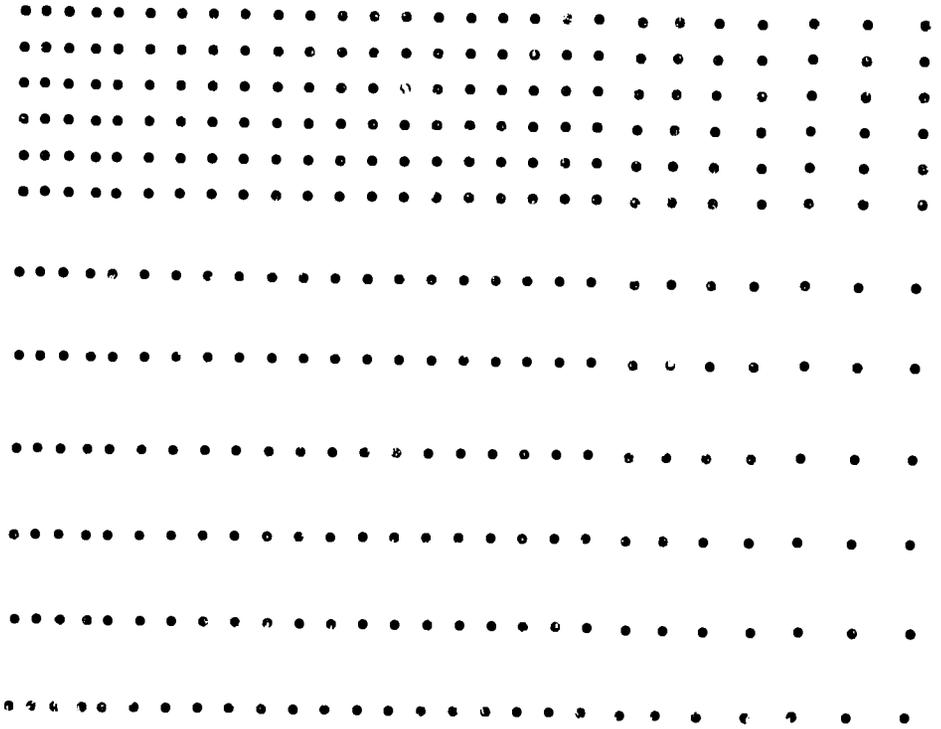
3. Weed/pest monitoring,
4. Tree/crop interaction over time viz a viz crop yield
 - (a) Crop yield (grain and crop residue), and
 - (b) Tree biomass yield, and
5. Agroforestry Management Studies
 - (a) Tree cutting heights and frequencies, and
 - (b) Tree canopy management and husbandry practices.

Production costs such as labour and purchased inputs (seeds, fertilizers, insecticides, labour, etc) are also kept for both the research and control plots so as to assess each module's efficiency with respect to land, labour and capital used.

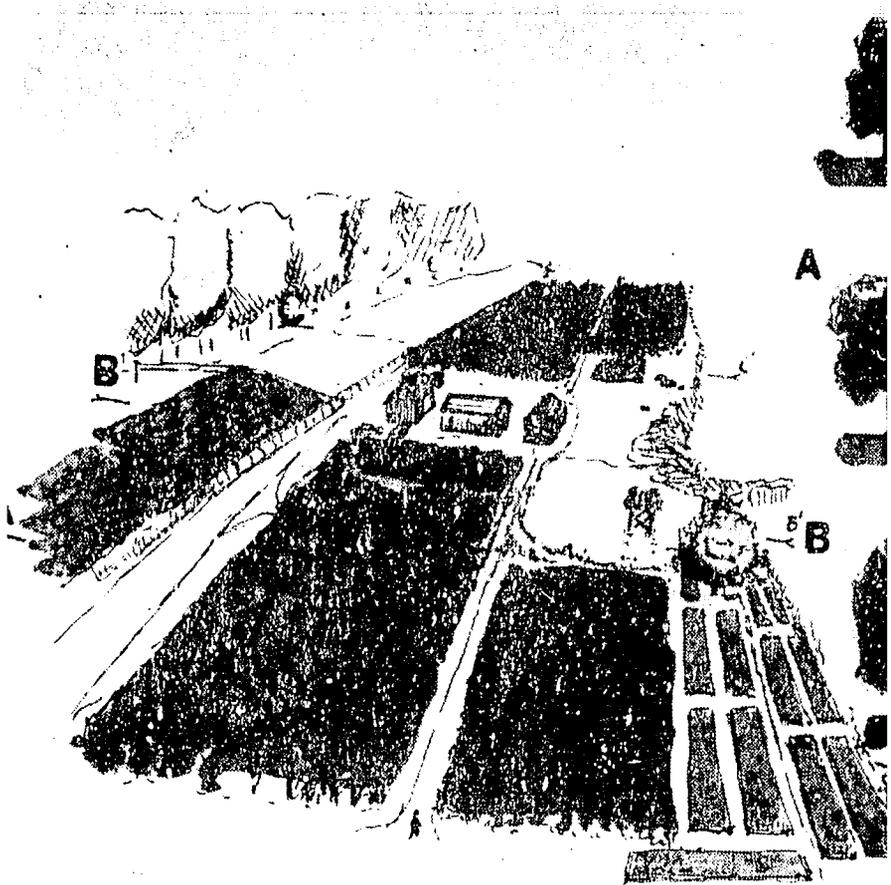


Agroforestry Research and Demonstration. *This illustration from the demonstration plots at Ngong/Jamhuri shows beans growing between rows of *Grevillea robusta*. The beans are growing very well due to the service roles of the trees (soil conservation and improvement, water conservation, wind break, etc.).*

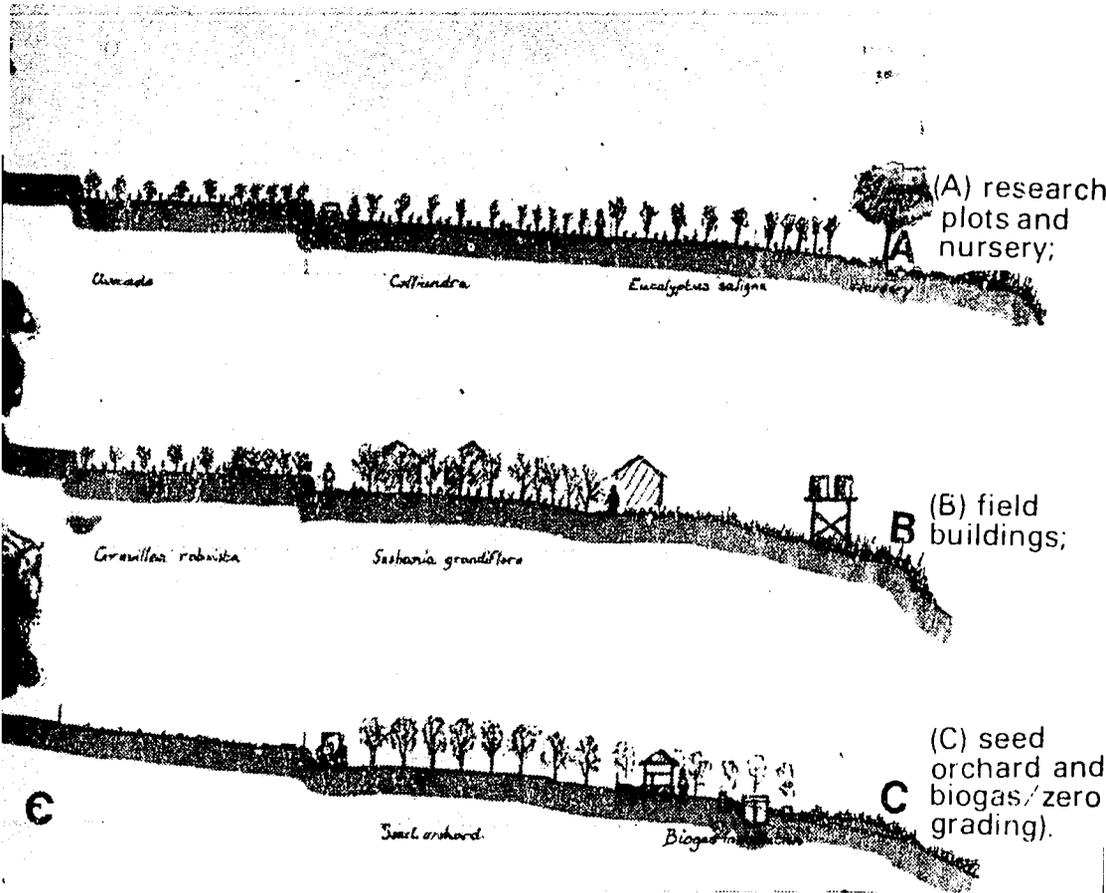
Figure 3. Planting Plan of the Trees in the Parallel Systematic Design



The between row spacings are 2 meters and 4 meters while the within row spacings range from 0.5, 1.0, 2.0 and 3.0 meters.



Artists drawing of the layout of the Jamhu
drawing on the left shows the different co
side shows the cross section of these cor



section of the Ngong /Jamhuri Agroforestry/ Energy Centre. The ponents that make up the Centre programme while the right one

1/6

Fig. 4A. Agroforestry experimental trials planting arrangements.

		Line Density			
Row Width		0.5m	1m	2m	3m
2m	Module	2A	2B	2C	2D
	Density	1m ²	2m ²	4m ²	6m ²
4m	Module	4A	4B	4C	4D
	Density	2m ²	4m ²	8m ²	12m ²

Fig. 4B. Agroforestry experimental trials planting densities.

Area per Tree	1m ²	2m ²	4m ²	6m ²	8m ²	12m ²
Trees per ha	10,000	5,000	2,500	1,666	1,250	833
Module	2A	2B 4A	2C 4B	2D	4C	4D

Some Preliminary Results/Recommendations

The agroforestry experiments and the species screening trails described above are expected to provide information on the optimum arrangements for agroforestry systems for the upland savannas region. Results to date on agroforestry as well as on suitable species for peri-urban plantations are inconclusive mainly due to prevailing drought conditions in the region. However, tree establishment and initial growth rates are encouraging (Appendices 4 and 5).

Tree Species Choice

The preliminary results indicate that there are several good species for this environment to choose from. For peri-urban and/or village woodlots the species that appear to be promising are: *Eucalyptus saligna*, *E. maculata*, *E. paniculata*, *E. microcorys*, and *Tipuana tipu*.

Species for agroforestry systems of land use for woodfuel, fodder/browse or multi-purpose use include: *Calliandra calothyrsus*, *Grevillea robusta*, *Sesbania sesban*, and *Sesbania grandiflora*. The recommended list for species is given in Appendix 6.

Planting Design and Establishment

Land should be prepared for agricultural crops before the trees are established. The best crops for planting with trees the first year (nurse crops) include cassava, maize and castor beans. Rows of trees should be planted simultaneously with the crops.

Trees should be planted at 4 or more meters between the rows and 0.5 to 2 meters between trees within the row depending on the tree species. A 4m x 1m spacing (2500 trees/ha) is recommended for many tree species.

(e) Extension/Training/Technical Services

This component of the programme at Ngong/Jamhuri Agroforestry/Energy Centre has recently expanded due to activities taking place in the proximity of the Centre, for example the Nairobi ASK show which takes place annually in September and the mass tree planting by University of Nairobi students at Kiserian near Ngong town.

Training activities take place in the Ngong/Jamhuri Centre. Groups of farmers, students from various institutions, Boy Scouts and NGOs are regularly given on-site training by the centre's extension/technical staff.

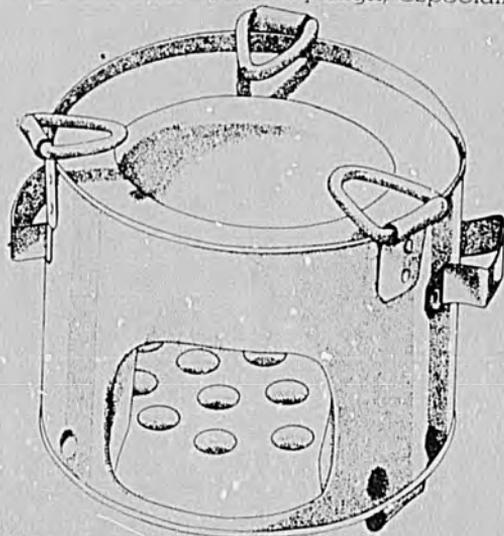
Farmers and, GOK and NGO officials can participate in training at Ngong FTC on aspects of agroforestry practices, nursery management, and seed and seedling technology (including tree species which would do better in their respective zones). A total of 23 contact farmers have already been identified around Ngong Division and work is due to start at the outset of the long rains.

The extension services have greatly improved with the provision of one extension vehicle, five motorcycles and five bicycles. Dissemination of information through technical and information bulletins will greatly improve the extension efforts.

The extension program offers material assistance to organizations by supplying seeds, polythene bags and seedlings. Technical services given include directions on tree planting, agroforestry techniques, nursery management, seed procurement, etc. To date, technical services have been given to organized groups in Limuru, Kajiado, the Muka Mukuu polytechnic near Thika, and many small school or group projects.

Improved Cookstoves and Charcoal Kilns

At Jamhuri, production/training courses are conducted on improved cookstoves technologies. Trainees are taught how to fabricate metal claddings and mould clay liners for both wood burning and charcoal stoves. The demand for the improved stoves in Nairobi is very high, especially among



The Kuni-Mbili Woodstove. *This stove uses wood (kuni) much more efficiently than the traditional 3-stone fire.*

government officers and city dwellers. These stoves have great potential to help save money for the urban poor while at the same time decreasing the pressure on Kenya's limited woodfuel resources.

To multiply the efficient use of charcoal with improved cookstoves, charcoal should be produced efficiently. To this end, a half orange (Argentina model) brick kiln has been erected at Jamhuri Centre with expertise from a G.T.Z. programme. Evaluation tests of the performance of the charcoal brick kiln are underway. Once the model has been adequately assessed and proven efficient, demonstrations will be carried out with the Forest Department of the Ministry of Environment and Natural Resources, where large scale charcoal production activities are being carried out by licensed charcoal dealers.

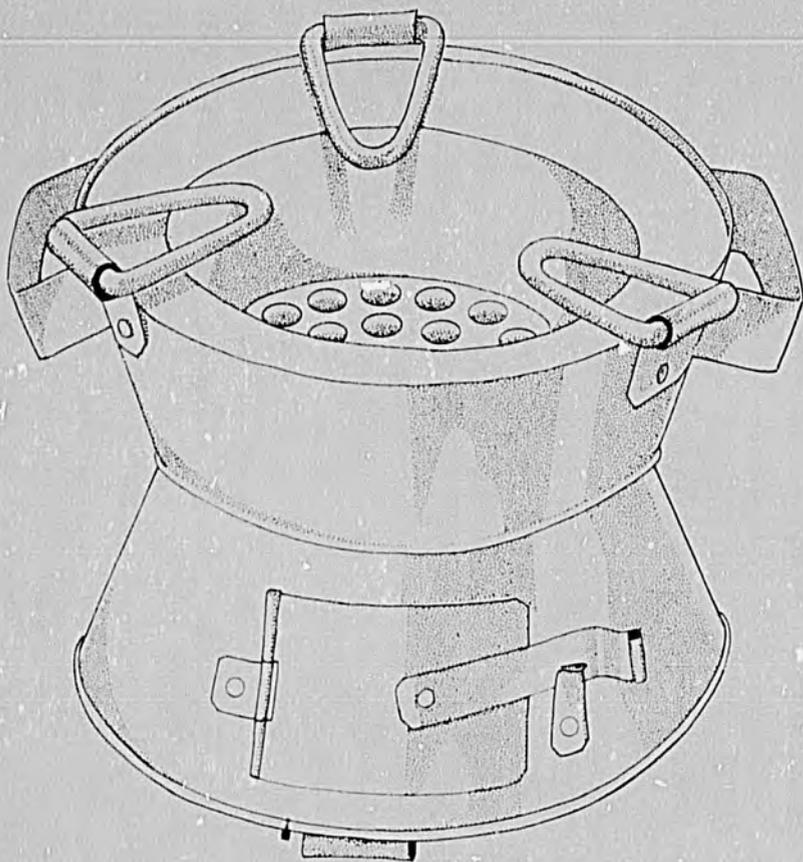
Production/training courses for cookstoves or kilns last from 5-10 weekdays, and participants are drawn from village polytechnic graduates, instructors, traditional jiko makers,



The Argentinean Half-Orange Kiln. *This kiln at Jamhuri is being used extensively for both research and demonstration purposes. The Project is presently arranging with the Forest Department to construct several kilns in the Ngong and Karura Forests in order to increase the yields of charcoal from these fuelwood plantations.*

and others who have aptitude on sheet metal or pottery skills.

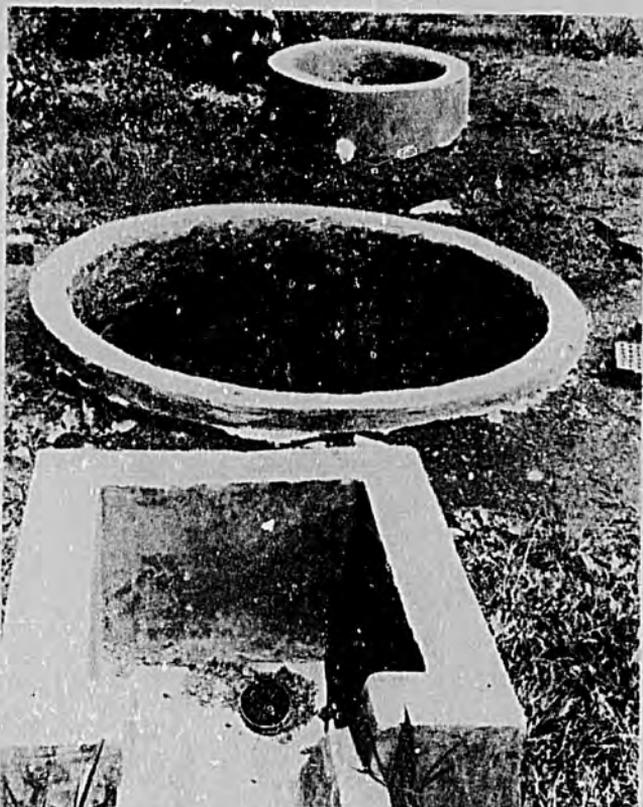
Participation in the course is free, however, preference is given to those who have sponsors.



The Kenya Ceramic Jiko. *The Kenya Ceramic Jiko has been one of the most successful developments of the project with thousands of units sold throughout Kenya every month. This jiko (charcoal stove) requires only half the charcoal as the traditional metal stove and therefore saves a considerable amount of money for the user while at the same time decreasing the demand for wood from the indigenous forests of Kenya.*

Biogas

Biogas is a combustible fuel gas, produced during the decomposition of organic matter (especially animal manure). As organic matter decomposes in the absence of oxygen, biogas (also called methane) and carbon dioxide are produced; biogas being 60-65% of the total gas production and carbon dioxide 35-40%. A few other trace gases, such as hydrogen sulfide, may also be produced in small quantities.



Biogas Unit at Jamhuri. *There are two biogas demonstration units at Jamhuri. These have been used extensively for both training and demonstration purposes. In addition, there are three biogas experts at Jamhuri who conduct training in biogas technology all over the country.*

Biogas production has the additional advantage of improving the waste materials used. During the decomposition, worms, various types of parasites, and

several types of micro organisms, which were in the original dung or vegetable matter, are destroyed. The final slurry (as it is called) is free from offensive odours and will not attract flies or other insects. The slurry is also a better fertilizer or soil conditioner than the original dung or vegetable matter.

Biogas has many uses; some of these are cooking, lighting, water heating, heating of piggeries and running engines. Using the biogas demonstration units at Jamhuri, the Ministry has trained several biogas artisans, who are now competent in the construction and maintenance of family size biogas units.

The training of biogas artisans is an on-going programme at Jamhuri for people interested in learning how to build biogas digesters. Each biogas course lasts about 10 days. A knowledge of masonry is advantageous for course participants.

Staff - Ngong/Jamhuri

Centre Manager	- P.M. Makenzi
Centre Clerk	- P.W. Mwangi
Foreman/Ngong	- Meshack Owour
Foreman/Jamhuri	- Heron Hussein
Nursery headman/Ngong	- James Gichorah
Nursery headman/Jamhuri	- Robert Akoyo
Extension Officers	- Mary Schuler
	- Munene Kahiro
Storeman/Ngong	- Wilberforce Davis Odongo
Storeman/Jamhuri	- Isaiah Chibaliah
Coordinator, Central	
Seed Services Unit	- Alice Kaudia

Associated staff

Mr E. Antao	- Forester, Ngong Forest Station
Mrs Njoroge	- Soil Conservation Officer, Nairobi
Mr C. Muchemi	- District Soil Conservation Officer, Kajiado
Mrs D.A. Rajuai	- Principle FTC, Ngong
Mr Mwoga	- Agricultural Officer, Ngong

Appendix 1

Current tree species in the seedling production programme

1. *Aberia caffra*
2. *Acacia gerrardii*
3. *Acacia mearnsii*
4. *Acacia melanoxylon*
5. *Acacia nilotica*
6. *Acacia podalyriifolia*
7. *Acacia saligna*
8. *Acacia xanthophloea*
9. *Acrocarpus fraxinifolius*
10. *Adansonia digitata*
11. *Azelia cuarizensis*
12. *Albizia* sp.
13. *Albizia gummifera*
14. *Allophylus abyssinicus*
15. *Annona squamosa*
16. *Azadirachta indica*
17. *Bauhinia* sp.
18. *Bombax* sp.
19. *Caesalpinia spinosa*
20. *Callistemon* sp.
21. *Calodendrum capense*
22. *Carica papaya*
23. *Cassia abbreviata*
24. *Cassia siamea*
25. *Cassia spectabilis*
26. *Castanospermum australe*
27. *Casuarina equisetifolia*
28. *Citrus limon*
29. *Colophospermum mopane*
30. *Cordia abyssinica*
31. *Cordouexia edulis*
32. *Croton megalocarpus*
33. *Cupressus lusitanica*
34. *Dalbergia melanoxylon*
35. *Dalbergia sissoo*
36. *Delonix regia*
37. *Diospyros abyssinica*
38. *Entada abyssinica*
39. *Ensete ventricosum*
40. *Erythrina* sp.
41. *Eucalyptus* sp.
42. *Eucalyptus maculata*
43. *Eucalyptus microcorys*
44. *Eucalyptus paniculata*
45. *Eucalyptus saligna*
46. *Eugenia jambos*
47. *Ficus* sp.
48. *Ficus capensis*
49. *Flamingia congesta*
50. *Fraxinus mexicana*
51. *Gliricidia sepium*
52. *Grevillea robusta*
53. *Hekea saligna*
54. *Jacaranda mimosifolia*
55. *Kigelia africana*
56. *Leucaena leucocephala*
57. *Leucaena pulverulenta*
58. *Mangifera indica*
59. *Markhamia hildebrandtii*
60. *Melia azedarach*
61. *Milletia dura*
62. *Moringa oleifera*
63. *Oncoba spinosa*
64. *Parkinsonia aculeata*
65. *Passiflora edulis*
66. *Peltophorum africanum*
67. *Persea americana*
68. *Pinus patula*
69. *Pistacia aethiopica*
70. *Podocarpus gracilior*
71. *Prosopis chilensis*
72. *Psidium guajava*
73. *Pterogyne nitens*
74. *Punicum granatum*
75. *Schinus molle*
76. *Schrebera alata*
77. *Sesbania bispinosa*
78. *Sesbania grandiflora*
79. *Shizolobium parahybum*
80. *Simmondsia chinensis*
81. *Spartium junceum*
82. *Spathodea nilotica*
83. *Sterculia acertifolia*
84. *Syzygium cumini*
85. *Teclea nobilis*
86. *Tecoma stans*
87. *Terminalia* sp.
88. *Thevetia peruviana*
89. *Tipuana tipu*
90. *Trachylobium verrucosum*
91. *Vitex keniensis*

Appendix 2

Partial List of Tree Seed Available from the Centre

SPECIES	SOURCE		
	Seed Orchard	Local Collection	From other Centre
<i>Aberia caffra</i>		X	
<i>Acacia albida</i>		X	
<i>Acacia cyanophylla</i>			X
<i>Acacia podalyriifolia</i>		X	
<i>Acrocarpus fraximifolius</i>		X	
<i>Albiza gummifera</i>			X
<i>Aleurites moluccana</i>		X	
<i>Araucana kirka</i>		X	
<i>Balanites aegyptiaca</i>			X
<i>Bauhinia purpurea</i>	X		
<i>Bombax sp.</i>		X	
<i>Brachychiton populneum</i>		X	
<i>Caesalpinia spinosa</i>		X	
<i>Calliandra calothyrsus</i>	X		
<i>Callistemon sp.</i>		X	
<i>Calodendrum capense</i>		X	
<i>Canthium komense</i>		X	
<i>Cassia stamea</i>		X	X
<i>Cassia spectabilis</i>		X	
<i>Casuarina cunninghamiana</i>		X	
<i>Casuarina equisetifolia</i>		X	X
<i>Cordia abyssinica</i>	X	X	X
<i>Crabia brownii</i>		X	
<i>Croton macrostachyus</i>		X	X
<i>Croton megalocarpus</i>		X	
<i>Eriobotrya japonica</i>		X	
<i>Erythrina sp.</i>		X	
<i>Eucalyptus maculata</i>		X	
<i>Eucalyptus saligna</i>		X	
<i>Flemingia conjesta</i>	X		X
<i>Fraxinus mexicana</i>		X	
<i>Grevillea robusta</i>		X	X
<i>Jacaranda mimosifolia</i>		X	
<i>Juniperus procera</i>		X	
<i>Leucaena leucocephala</i>	X	X	X
<i>Leucaena pulverulenta</i>	X		
<i>Macadamia integrifolia</i>		X	
<i>Markhamia hildebrandtii</i>		X	
<i>Markhamia platycalyx</i>			X

Melia azedarach		X	X
Melia volkensii			X
Millettia dura		X	
Podocarpus gracilior		X	
Prosopis chilensis			X
Prunus africana		X	
Pterogyne nitens		X	
Schinus molle		X	
Sesbania grandiflora	X		X
Spathodea nilotica		X	
Sterculia acerfolia		X	
Syzygium cumini		X	
Tecoma stans		X	
Thevetia peruviana		X	
Tipuana tipu		X	
Vitex keniensis		X	



Cordia abyssinica, a very promising indigenous tree which does well with agricultural crops and also provides timber and woodfuel

Appendix 3

Rainfall data for Ngong/Jamhuri in mm

Month	Year		
	1982	1983	1984
January	NIL	5.6	2.8
February	19.5	179.3	NIL
March	46.0	32.0	7.5
April	258.6	222.0	54.0
May	161.5	38.7	7.1
June	48.5	29.1	5.5
July	13.0	14.0	8.0
August	7.5	26.6	3.1
September	47.0	NIL	23.4
October	147.2	31.2	84.1
November	251.5	56.7	106.8
December	169.6	267.3	67.0
Total	1169.9	902.5	369.3

Appendix 4

Tree performance in Ngong/Jamhuri Research plots as of July 1984

Species	Date Planted	Survival Rate	Average growth per Month (cm)
<i>Calliandra calothyrsus</i>	June 1983	87%	14.3
<i>Eucalyptus saligna</i>	April 1983	99%	12.6
<i>Grevillea robusta</i>	April 1983	100%	11.9
<i>Persea americana</i>	May 1983	40%	3.8
<i>Sesbania grandiflora</i>	April 1983	97%	10.8

Appendix 5

Tree Species Performance in the Ngong/Jamhuri Screening (Seed Orchard) Trials.

No.	Species	Date Planted	Survival Rate	Average Height (cm)
1.	<i>Acacia albida</i>	26-4-83	100%	48.1
2.	<i>Acrocarpus fraxinifolius</i>	25-4-83	100%	91.9
3.	<i>Balanites aegyptiaca</i>	27-4-83	91%	21.0
4.	<i>Bauhinia purpurea</i>	26-4-83	94%	102.9
5.	<i>Brachylaena hutchinsii</i>	27-4-83	83%	40.7
6.	<i>Caesalpinia spinosa</i>	27-6-83	100%	122.6
7.	<i>Calliandra calothyrsus</i>	6-6-83	94%	93.9
8.	<i>Cassia siamea</i>	26-4-83	100%	63.5
9.	<i>Casuarina equisetifolia</i>	25-4-83	100%	176.8
10.	<i>Cordia abyssinica</i>	27-4-83	100%	184.8
11.	<i>Croton megalocarpus</i>	25-4-83	100%	75.2
12.	<i>Eriobotrya japonica</i>	26-4-83	100%	55.0
13.	<i>Eucalyptus maculata</i>	25-4-83	100%	156.1
14.	<i>Eucalyptus paniculata</i>	25-4-83	100%	196.6
15.	<i>Eucalyptus saligna</i>	25-4-83	100%	185.6
16.	<i>Filicium decipiens</i>	26-4-83	88%	20.5
17.	<i>Flamingia congesta</i>	26-4-83	100%	148.6
18.	<i>Gliricidia sepium</i>	7-8-84	80%	29.1
19.	<i>Grevillea robusta</i>	25-4-83	100%	110.6
20.	<i>Leucaena leucocephala</i>	26-4-83	100%	115.2
21.	<i>Leucaena pulverulenta</i>	6-6-83	100%	106.3
22.	<i>Macadamia integrifolia</i>	26-4-83	100%	66.7
23.	<i>Markhamia hildebrandtii</i>	27-4-83	100%	44.8
24.	<i>Prosopis chilensis</i>	6-6-83	100%	111.2
25.	<i>Sesbania grandiflora</i>	6-6-83	97%	85.5
26.	<i>Spathodea nilotica</i>	25-4-83	97%	44.6
27.	<i>Tipuana tipu</i>	26-4-83	97%	229.2
28.	<i>Vitex keniensis</i>	25-4-83	100%	39.1

Appendix 6

Tree species potentially suitable for the Upland Savannas

1. Fodder/Browse

- Acacia albida
- Acacia nilotica
- Acacia seyal
- Balanites aegyptiaca
- Calliandra calothyrsus
- Leucaena leucocephala
- Sesbania grandiflora
- Sesbania sesban

2. Timber/Fuelwood

- Acrocarpus fraxinifolius
- Azadirachta indica
- Brachylaena hutchinsii
- Calodendrum capense
- Cassia siamea
- Casuarina equisetifolia
- Cordia abyssinica
- Croton megalocarpus
- Eucalyptus maculata
- Eucalyptus paniculata
- Eucalyptus saligna
- Grevillea robusta
- Jacaranda mimosifolia
- Parkinsonia aculeata
- Pterogyne nitens
- Schinus molle
- Tipuana tipu

3. Fencing

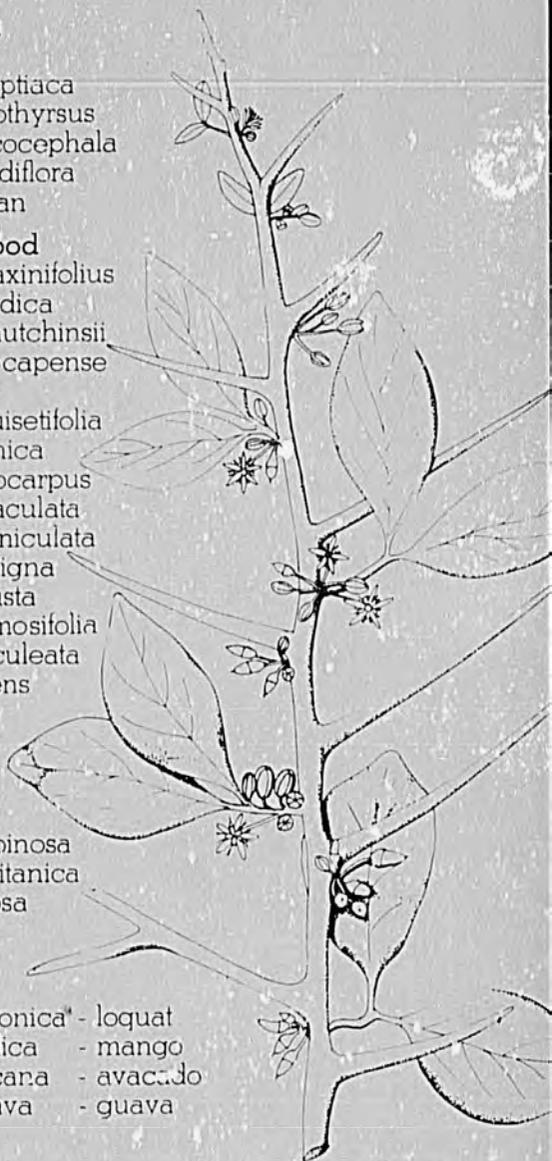
- Aberia caifra
- Caesalpinia spinosa
- Cupressus lusitanica
- Oncoba spinosa

Fruit Trees

- Citrus sp.
- Eriobotrya japonica* - loquat
- Mangifera indica - mango
- Persea americana - avocado
- Psidium guajava - guava

* More important species.

Balanites aegyptiaca, a native species to the upland savannas, provides good fire wood, fodder, fruits, medicines and timber.



For more information or assistance, please contact the
Centre Manager of Ngong/Jamhuri Agroforestry/Engery
Centre:

Ngong/Jamhuri Agroforestry/Energy Centre
P O Box 21552
NAIROBI

.....
Application form for classes

Name: _____

Address _____

Telephone number where you can be contacted _____

Check which class you are interested in attending

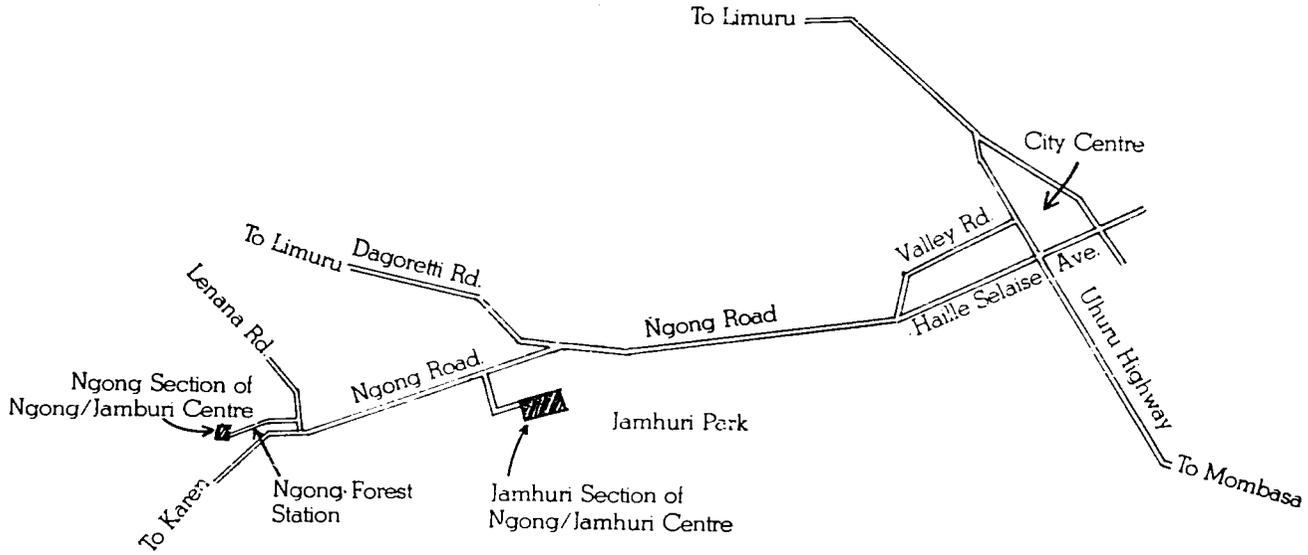
Agroforestry

Biogas

Improved cookstoves/kiln

State reason you would like to take the class.

Please send this form to Ngong/Jamhuri
Agroforestry/Energy Centre



Map to Ngong/Jamhuri Agroforestry/Energy Centre