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Kitui

Agroforestry Energy Centre
Information Bulletin No. 1

Kenya Renewable Energy Development

**Kenya
Renewable
Energy
Development
Project
(KREDP)
September
1985**

The Kitui 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:

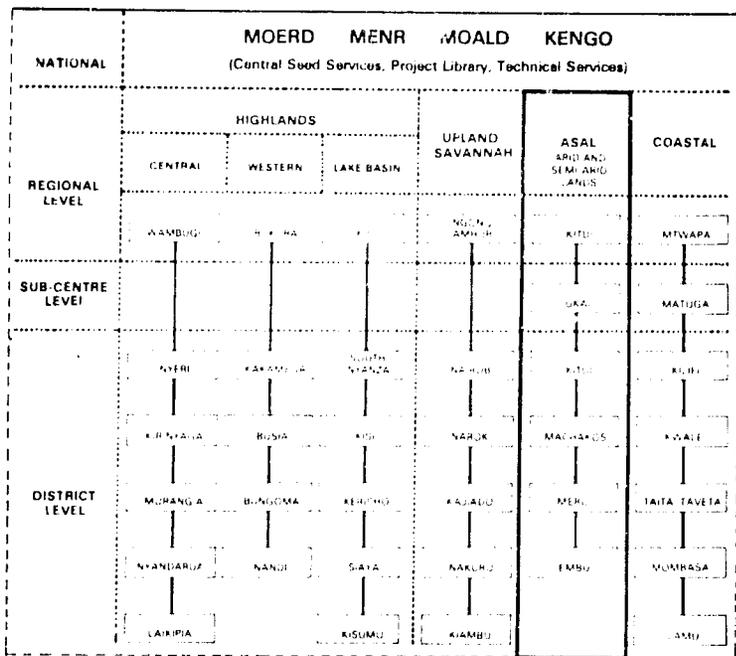
- Ministry of Agriculture and Livestock Development (MOALD),
- Ministry of Environment and Natural Resources (MENR), and
- Kenya Energy Non-Governmental Organizations Association (KENGO).

The physical, institutional and operational basis of KREDP are the six regional Agroforestry Energy Centres of which Kitui 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 (EDI), a private consulting firm.

Figure 1.

Regional and District Programmes



Programmes covered in this bulletin.

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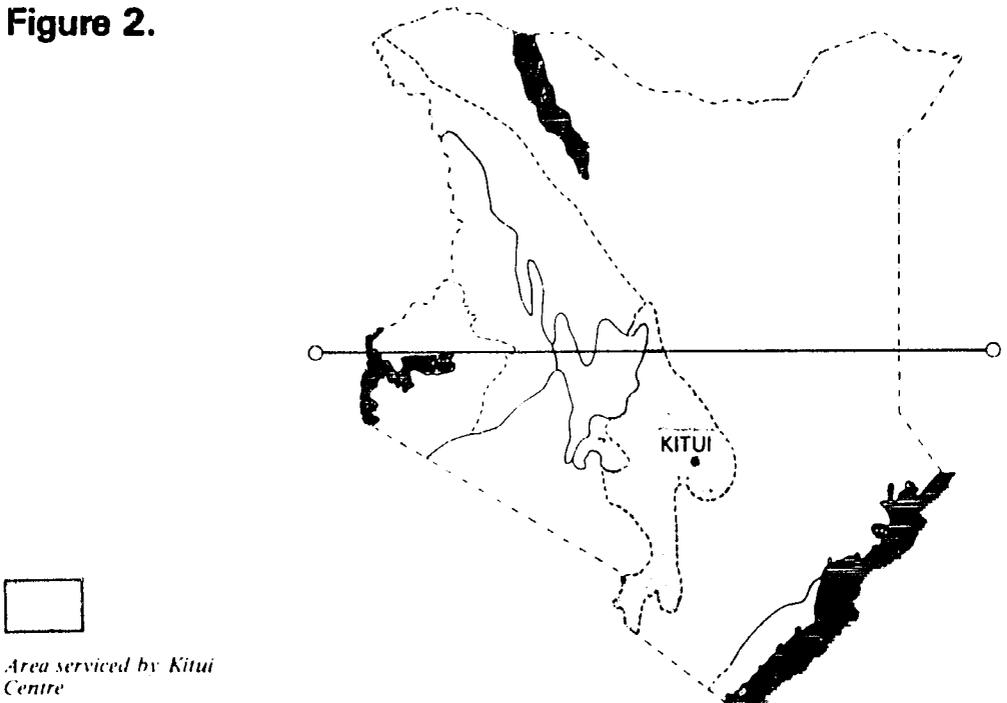
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Location

The Kitui Centre is one of six Regional Agroforestry/ Energy Centres. The establishment of the centre was initiated in May, 1982. The Centre is physically housed within the 400 acres of the Better Living Institute (BLI), a farmers training centre that enjoys joint parenthood from the Ministry of Health (MOH) and the Ministry of Agriculture and Livestock Development (MOALD). The UKAI Agroforestry/ Energy Sub-Centre (established in November 1983) is housed by the Ukamba Agricultural Institute — a training institution for Agricultural extension workers.

The Centre and Sub-Centre were established to serve the semi-arid zone shown in Figure 2. This region receives an average of less than 1000 mm rainfall per year. It has good potential for agroforestry and other renewable energy technologies. The region is presently a major supplier of wood and wood products as well as livestock to many urban centres in Kenya, particularly Nairobi. As a result, it is experiencing active deforestation and woodfuel shortages. An agroforestry-based land use system has great potential to help alleviate these problems by providing a permanent renewable source of woodfuel.

Figure 2.



Goals and Objectives

As part of the national renewable energy development effort, the centre serves to:

- Reduce deforestation and environmental degradation in the region through increased tree planting efforts, particularly by the application of agroforestry techniques;
- Reduce demand on the present national woodfuel reserves through the introduction of more efficient stoves, charcoal production techniques (kilns), biogas, and other renewable energy technologies; and
- Develop institutional infrastructures for renewable energy development programmes.



THE KENYA CERAMIC JIKO. The Kenya Ceramic Jiko has been one of the most successful developments of the project, not only saving considerable money for the user, but decreasing the overall demand for wood from the indigenous forests. In this picture, participants in one of the Centre's programmes learn about the benefits of this improved cookstove.

Present Programme Components

To achieve the above stated objectives, the centre and sub-centre operate the following programmes and activities:

- Tree species screening and evaluation trials;
- Tree seed services (from both seed orchards and local collection) and bulking of cassava cuttings;
- Central tree seedling nurseries;
- Agroforestry research demonstration plots and on-farm demonstrations;
- Training, extension and technical services in agroforestry;
- Improving stoves development, artisans training and demonstration;
- Biogas technology development and artisans training; and
- Charcoal kiln (portable and permanent) testing and demonstration.



CHARCOAL KILNS. One of the programme areas at the Kitui Centre covers charcoal kilns. Here, the portable charcoal kiln is being demonstrated during a tour of the centre.

**Physical
Developments
Completed
(1985)**

The centre at Kitui and its sub-centre at UKAI have been given full access to existing training, research and physical facilities of the BLI, UKAI, Thome Wa Akiisto and the Diocese of Kitui Goat and Sheep Project. These include classrooms, conference rooms, dormitories, catering facilities, offices, stores, farms and farm machineries, livestock and transport vehicles. The Kenya Renewable Energy Development Project has, however, developed the following:

Structures:

- 2 Office Buildings (Kitui, UKAI),
- 1 Jiko Production/ Training and Demonstration Workshop (Kitui),
- 1 Portable charcoal kiln (Kitui),
- 2 Dams rehabilitated to about 20 million gallons capacity,
- 1 Water reservoir tank (20,000 gallons) with piping,
- 1 Biogas Unit (Kitui), and
- 1 Improved charcoal kiln (Kitui).

Nurseries:

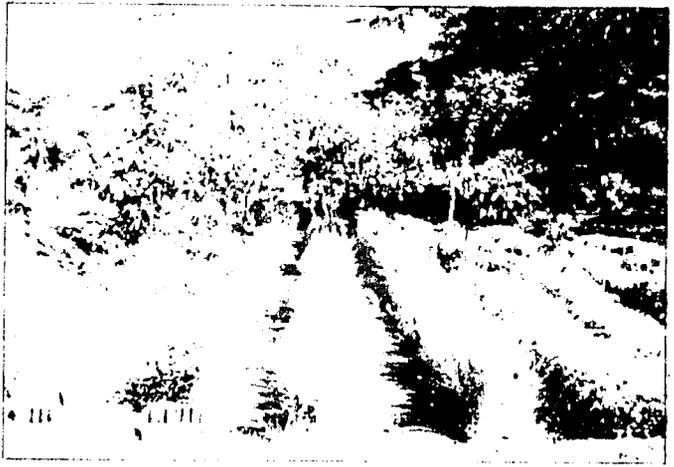
The Kitui centre nursery has a production capacity of 2 million seedlings per year, while the UKAI Sub-Centre nursery has a capacity for 300,000 seedlings.

Seed Orchards:

(Species screening trails) 3.0 hectares at Kitui and 1 hectare at UKAI.

Research/Demonstration Farms:

10 hectares at Kitui and 5 hectares at UKAI.



NURSERIES. The Kitui nursery has an annual production capacity of 2 million seedlings of a wide variety of species.

(a) Nurseries:

The central nurseries at Kitui and UKAI serve as a source of tree seedlings as well as for demonstration and training facilities. Practical training given to farmers, schools and NGO's active in tree planting includes:

- Tree seed collection, processing and storage;
- Propagation methods including seed pre-treatment, germination, cuttings and budding,
- Nursery management including site selection and preparation, seedbeds and seedling beds, seed sowing, watering water conservation, weeding and pruning, and
- Tree planting including handling, transportation, planting sites, hole digging, transplanting and protection.

Seedlings of more than thirty tree/shrub species (Appendix 1) are produced by the Centre in an attempt to cover a wide range of species including ones that are both ecologically suitable and demanded by farmers, schools and NGOs. The stock of seedlings being produced includes species for woodfuel, timber, soil and water conservation, fodder, and for fruits.

Seedling production and distribution to date (5 distribution seasons totalling about 1 million seedlings) indicate that the most desired species by the local community are:

- *Aberia caffra*,
- *Azadirachta indica*,
- *Cassia siamea* and *Cassia spectabilis*,
- *Casuarina equisetifolia*,
- *Croton megalocarpus*,
- *Eucalyptus paniculata*,
- Fruit trees, e.g., citrus, guavas and mango,
- *Grevillea robusta*, and
- *Leucaena leucocephala*.

The popular demand for these species is partially due to previous exposure to the species and their end-uses. These species are often observed both on farms and homesteads around Kitui. They have also proven to be the species in the centre's research trials which have high survival rates, are easy to establish, are draught and pest resistant and have high growth rates.

The nursery programme will continue to produce a wide range of species to cater for different needs. The quantities produced of each will depend on demand. The programme hopes to catalogue technical information on seed and nursery management techniques inherent to indigenous tree species and those introduced and naturalized in the dry areas.

Individuals may purchase seedlings (in polybags) for 25 cents each (MENR prices) and budded citrus for KShs. 5 per seedling. Groups (e.g., schools, institutions, churches, co-operatives and women self help groups) may obtain seedlings free of charge upon formal request to the Centre Manager. The centre also provides transport for such group requests as the distances (in the arid areas) from nurseries to planting sites remains one of the bottle-necks to tree planting and agroforestry. The Centre and Sub-centre issue seedlings during the National Tree Planting Day.

(b) Seed Orchard and Seed Services:

The Centre and Sub-Centre operate strong seed programmes through local seed collection (over 3 tonnes of seeds to date) and from seed orchards. This programme will be expanded as the Central Seed Services Unit in Nairobi become fully operational and as the district extension programmes expand.



SEED ORCHARD The seed orchards are used for species screening by recording the tree growth rates, and as sources of seed. Pictured is a group being given a tour through the stand of *Glucidia sepium*, an important species for agroforestry in the Kituu area.

Seed Orchards:

Currently, the centre operates a 4 hectare seed orchard made up of 44 species (Appendix 2). These orchards are replicated (both at Kitui and UKAI) and thus serve a second purpose of species screening and evaluation. The planting arrangement is as shown in Figure 3.

The replications are intercropped much like the agroforestry research demonstration plots and relevant agronomic and soil data are recorded (e.g., growth rates, survival, crop yields, soil fertility, etc.) Appendix 2 shows the list of species in the seed orchard with those which are currently producing seed indicated with an asterisk.

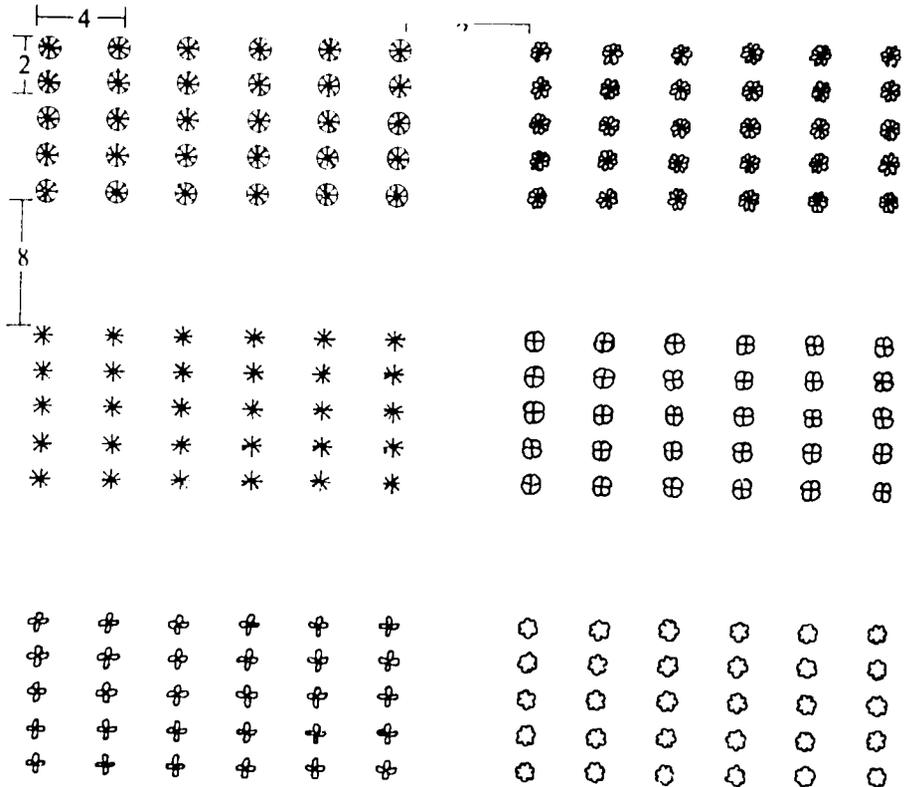


SEED SERVICES. The Kitui Centre operates a strong seed collection and distribution programme, both for use by the project and for distribution to local groups and programmes involved with tree planting. Pictured is one of the personnel at the Kitui Centre processing seeds for distribution.

Figure 3.

**Planting Plan of the Seed Orchards
(Screening Trials)**

The general ground plan is shown below. This figure represents only 6 blocks -- therefore 6 species. Within each block the trees are spaced 2 metres apart within the rows and rows are spaced 4 metres apart. The blocks are separated by 8 metres alleys on all sides. The blocks each contain 30 trees of one species.



Local Seed Collection:

The centre operates a seed collection programme for both introduced and economically important tree species, both to supplement seed yield from the seed orchards and the national collection programme.

(c) Agroforestry Research/Demonstration:

Background: Potentials and Constraints of the Region:

Kitui district, much like the rest of the arid and semi-arid areas of Kenya, is socio-economically undergoing transition from a traditional pastoralism to sedentarized agriculture. Both overgrazing and indiscriminate land clearing (often clear felling) either for fuelwood or for crop production are causing accelerated soil erosion and general environmental degradation. With the population expected to double by the year 2000, these problems can only be expected to worsen.

Mismanagement of crop land and grazing land is the primary cause of accelerated erosion coupled with the highly erratic rainfall. The severity of erosion differs between districts and even divisions. The type of soils, which vary from clays to sands in this area, determines the degree of erodability. To have sustained and increased agricultural production calls for concerted efforts in soil and water conservation.

Without intervention, including the adoption of agroforestry and related water and conservation measures, land productivity will slowly decrease, just when higher population levels require that it increase.

Agroforestry is a timely answer, being a system that incorporates soil and water conservation, increases and sustains the production of crops and animal, and as well, provides fuelwood which helps to alleviate the woodfuel crisis.

Description of the Agroforestry Research Programme:

Large research and demonstration farms of 10 hectares at Kitui and 5 hectares at UKAI have been developed. These farms serve as teaching demonstration tools besides generating biotechnical data on which to base the agroforestry recommendations and technology packages of the extension programme. There are a total of 13 tree species under agroforestry experiments, namely:

<i>Acacia albida</i>	<i>Anacardium occidentale</i>
<i>Cassia siamea</i>	<i>Casuarina equisetifolia</i>
<i>Croton megalocarpus</i>	<i>Eucalyptus maculata</i>
<i>Giricidia sepium</i>	<i>Grevillea robusta</i>
<i>Leucaena leucocephala</i>	<i>Prosopis chilensis</i>
<i>Prosopis juliflora</i>	<i>Psidium guajava</i>
<i>Sesbania grandiflora</i>	

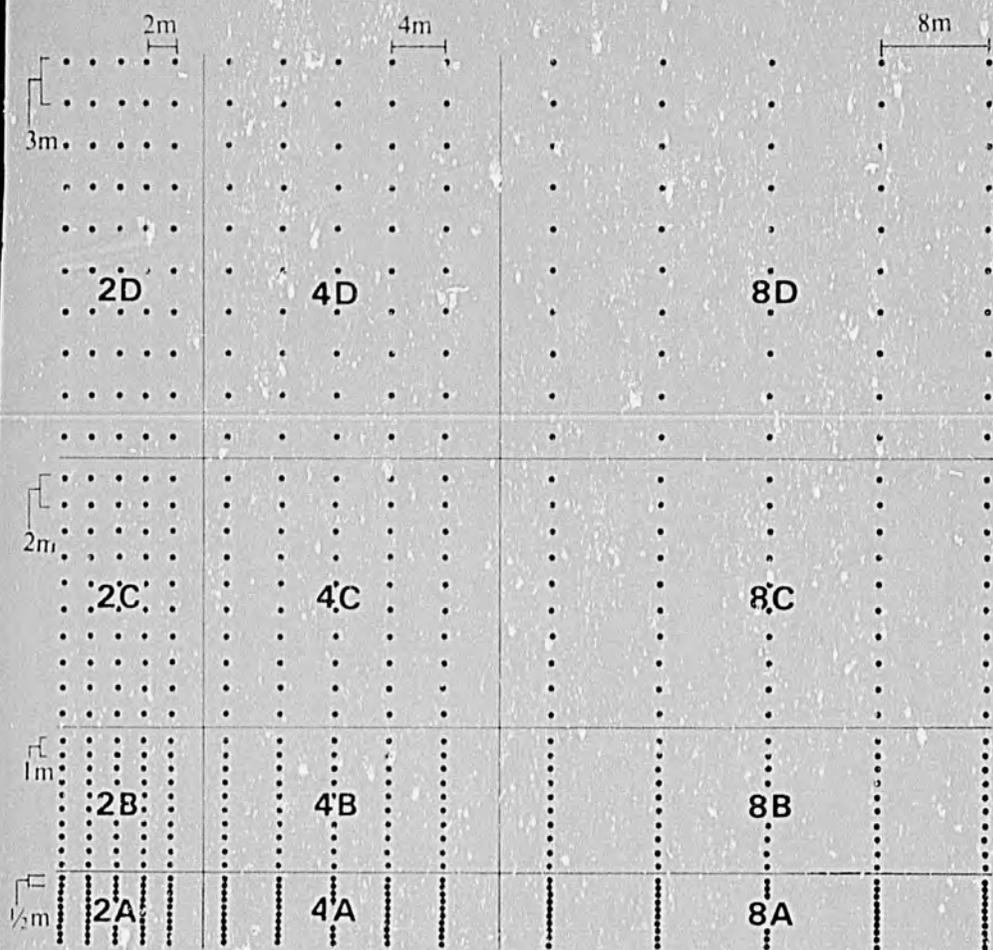
Six of these are replicated either at the Centre or the Sub-centre making a total number of 21 blocks. Figure 4 shows the basic research plot design in use, with 12 different



AGROFORESTRY. Agroforestry is a practice which can increase the overall productivity on a farm by improving the soil and providing products from the trees (woodfuel, fodder, fruits, etc.). Because of the trees' service roles, the soil and local environment is improved allowing sustainable production without a fallow period. Pictured is an example of one agroforestry practice. The tree is cut back periodically, (once or twice a year) and the wood is used for woodfuel while the leaves are either fed to livestock or dropped as green manure.

Figure 4.

Layout of the Research/Demonstration Plots



Each \bullet represents a tree. In each row there are 10 trees spaced $\frac{1}{2}$ meter apart, 10 spaced 1 meter, 10 spaced 2 meters, and 20 spaced 3 metres apart. After the first row there are 5 rows that are 2 meters apart, 5 that are 4 meters apart and 5 that are 8 meters apart. This gives the 12 different planting arrangements, from very dense to very dispersed. The crops are planted based on the recommendation of the Ministry of Agriculture and Livestock Development, regardless of the tree.

arrangements and 8 different densities (Figures 5A and 5B).

The data being collected in the research/demonstration plots each season include:

1. Soil fertility (both chemical and mechanical analysis),
2. Weed, pest and disease monitoring,
3. Crop yields,
4. Tree performance (height, diameter, survival rates), and
5. Tree management practices (pruning, pollarding coppicing, etc.).

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

Figure 5A. Agroforestry experimental trials planting arrangements

Row Width		Line Density			
		0.5m	1m	2m	3m
2m	Module	2A	2B	2C	2D
	Area per Tree	1m ²	2m ²	4m ²	6m ²
4m	Module	4A	4B	4C	4D
	Area per Tree	2m ²	4m ²	8m ²	12m ²
8m	Module	8A	8B	8C	8D
	Area per Tree	4m ²	8m ²	16m ²	24m ²

Figure 5B. Agroforestry experimental trials planting densities

Area per Tree	1m ²	2m ²	4m ²	6m ²	8m ²	12m ²	16m ²	24m ²
Trees per hectare	10,000	5,000	2,500	1,666	1,250	833	625	417
Modules	2A	2B 4A	2C 4B 8A	2D	4C 8B	4D	8C	8D

(d) Preliminary Results/Recommendations:

The agroforestry experiments described above are already providing information and preliminary conclusions. The following are some of the general observations to date:

1. High tree seedling survival and rate of growth as well as better growth form and canopy shape are obtained by establishing trees with crops. Maize, cassava, or pigeon peas are recommended as the initial nursing crop. The cost of tree establishment is minimal as all farm operations are for the agricultural food crop.



RESEARCH. The research programmes of KREDP are the cornerstones of all the other programmes. The research results are used to design the best agroforestry practices for promotion by the extension services. Extensive data are collected each planting season from each research plot. In the picture wood prunings from Cassia siamea are being weighed to determine the yields from the different planting densities.

-
2. Tree growth is generally better and economic returns from the land are higher with an agroforestry system than with pure agriculture or pure forestry systems. Marketable wood harvests (fuelwood, poles, fruits, fodder, etc.) are possible within two to four years from some tree species such as *Melia azedarach*, *Gliricidia sepium*, *Sesbania grandiflora*, *Psidium guajava*, *Cassia siamea*, *Tipuana tipu*, *Croton megalocarpus*, and *Leucaena leucocephala*.
 3. The trees which have performed the best as agroforestry species with little to no negative effects on crop yields are outlined below:

Horticultural Species:

Guava (*Psidium guajava*) has had good establishment and fruit production in less than two years. Cashewnuts (*Anacardium occidentale*) also initiated flowering early.

Woodfuel and Timber Species:

Economic harvests can be made within 2-4 years as opposed to 8-15 or more year cycles anticipated in the dry areas. The quantity of wood yield from *Cassia siamea*, *Sesbania grandiflora*, *Melia azedarach* and *Tipuana tipu* in 14 months has been very high. Of these species, *Sesbania grandiflora* stands out as actually providing increased crop yields. On the other hand, *Cassia siamea* was a heavy competitor with noticeable negative effects on crops.

Browse/Fodder and Multipurpose Species:

This group of woody shrubs shows the greatest promise in agroforestry with some species showing strong positive interaction with crops, i.e., crop yields were greater with the trees present than without. This group includes *Sesbania grandiflora*, *Gliricidia sepium*, *Leucaena leucocephala* and *Prosopis chilensis*. Their service roles in crop farming, in terms of soil fertility enhancement, soil and water conservation and biological weed control hold great promise.

4. Experience to date indicates the need for recommending multiple tree/shrub species to farmers and to emphasise that they grow a mixture of species with a prudent selection of planting sites (homesteads, terrace banks, farms, roadside, property/farm boundaries, badly eroded sites, catchment areas, etc.).

TREE SPECIES SCREENING. Pictured is *Cassia siamea* in the research plots. *Cassia siamea* showed great promise as it had the highest growth rate of any of the species tested. However, it subsequently proved to compete heavily with crops and thus had a negative interaction. As well, it proved to be susceptible to fungal attack. *Cassia* is thus no longer promoted for agroforestry. Negative results like this are also very important aspects of the research programme. *Cassia siamea* is still promoted for border planting, woodlots and soil conservation (away from crops) because of its unusually high growth rates.



5. The first major cutting of the tree, shrub species such as *Gliricidia*, *Leucaena* and *Sesbania* should not be carried out before a full canopy develops to maximise weed control, water conservation and biomass production. These effects are normally reached in 2-3 years in the 2 metre and a bit later in the 4 metre blocks.
6. If the trees (ex., *Leucaena*, *Gliricidia*, *Prosopis* and *Sesbania*) are allowed to grow large enough to have partial or full canopy closure, then shade tolerant vegetables (ex., radishes and lettuce) which could not normally be grown in the area can be grown for one or two seasons.
7. The tree planting modules (see Figures 4 and 5) to select for agroforestry systems for these multipurpose shrub

species appear to be in the relatively high density ranges, namely modules 2A and 2B, 4A and 4B, and 8A and 8B. For trees that are allowed to grow larger, for example fruit trees and timber trees, the wider spacings appear to present the best biological options (i.e., modules 4C and 4D, and 8C and 8D).

8. Probably the most important conclusion to be drawn from experience to date is that even though Kitui experienced severe draught (see Appendix 3) throughout the establishment period, the trees lived and grew. Even though there was complete crop failure, the trees were productive providing fuelwood, fodder and fruits as well as their service roles in soil and water conservation and improvement.



Extension and Technical Services. *The most important activities at the Kitui Centre are extension and technical services. It is through these programmes that the public learns about new agroforestry and other renewable energy technologies. Pictured is C.D.K. Muhia, the Kitui Centre Manager, explaining to a group of trainees the benefits of agroforestry.*

(e) Agroforestry Training, Extension and Technical Services

Training:

Using the facilities and services of the B.I. Thome Wa Akiisto, UKAI Institute, and the Multipurpose Training Centre, 6,401 farmers were trained in 1983 and 1984. The participants, who included farmers, NGOs, Assistant Chiefs, Chiefs, JTAs, TAs, and Headmasters, were addressed on all aspects of agroforestry based on the field programmes of the centre. Topics included seed collection, processing and storage; nursery management and tree planting; soil and water conservation; seed orchards; research activities; and energy substitution (solar, wind, biogas, etc.). These courses varied in length from one day to two weeks.

Extension/Technical Services:

This programme has recently been expanded by the Ministry of Agriculture and Livestock Development by integrating the District Soil and Water Conservation Extension Officers' activities with those of the centre and sub-centre technical staff. This is further strengthened by the posting of United States Peace Corps Volunteers to serve as extension officers and the procurement and issue of motorbikes, bicycles and training extension vehicles. The training and visit schemes of MOAID is also being used and will highly improve project impacts in the target districts, namely: Embu, Meru, Machakos and Kitui.

The extension service focuses on individual farmers in the target districts, but also covers selected schools, institutions, churches and other organised groups. The main technical packages include seasonal distribution and supply of seeds/seedlings, on-site technical advice, and supervision during major tree planting times.

Groups, farmers, students, NGOs, etc., are often given guided tours of the centre's operative units. The centre also participates in the National Tree Planting Day and at the District A.S.K. Shows. Printed extension information is being made available for District and lower level training extension efforts.

The Biogas Programme

The biogas programme is based at the B.I.I where one biogas unit was completed in 1984. An additional unit is under construction at the Kitui Centre. Pilot units for each Division are scheduled in order to teach the local masons the techniques and create awareness in the local community about this cost-effective energy-substitution method. These will be sited at Village Polytechnics.



BIOGAS. Biogas is a combustible fuel gas produced during the decomposition of animal manure. There are two biogas units at Kitui which are used extensively for both training and demonstration purposes.

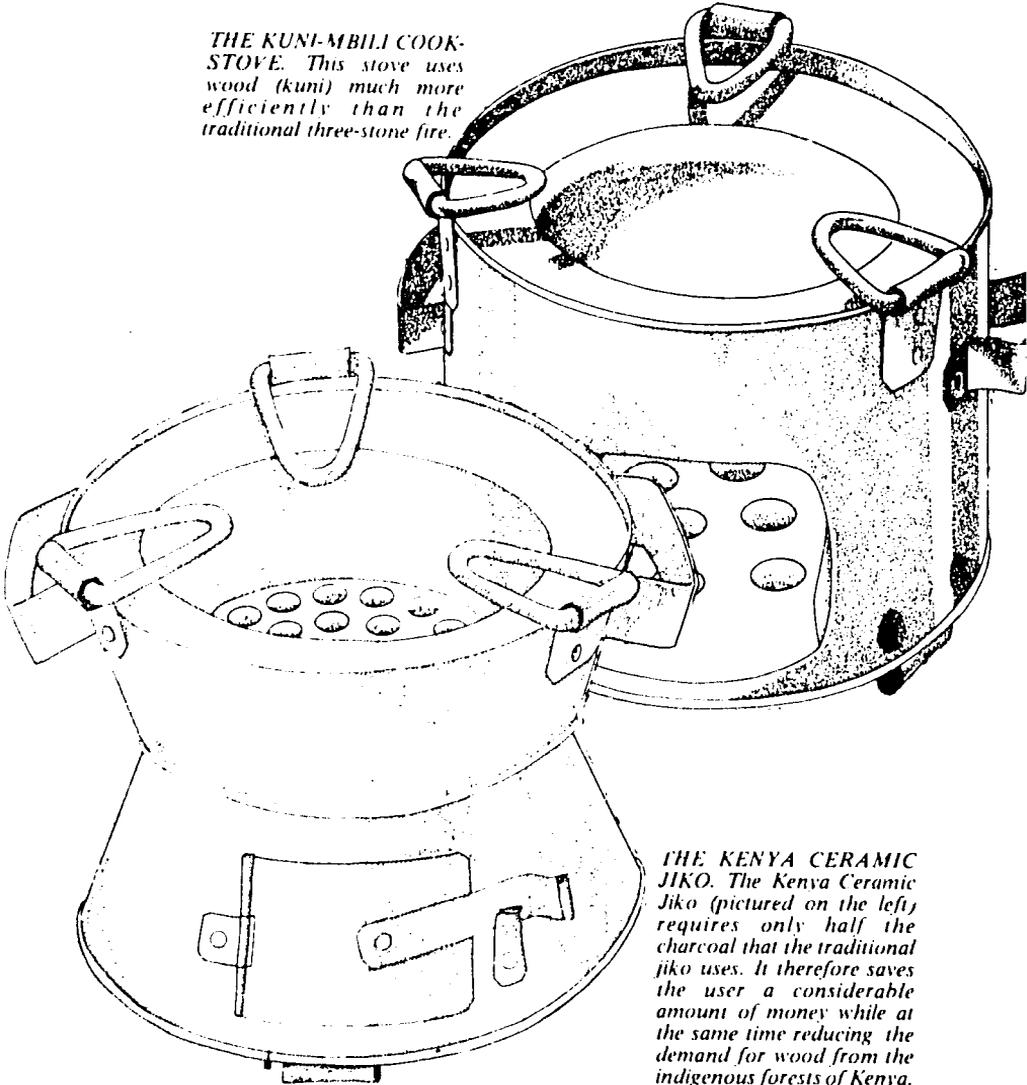
Cookstoves/ Kilns Programme

Stoves

The stoves programme at Kitui is relatively small but is expected to grow in terms of training and technical services. The demand for improved (energy efficient) stoves is high, especially among urban/peri-urban dwellers.

Training of artisans has been mostly with local jiko smiths (traditional jiko makers), but future focus will be with polytechnic teachers, and trainees from NGO's including organised women groups.

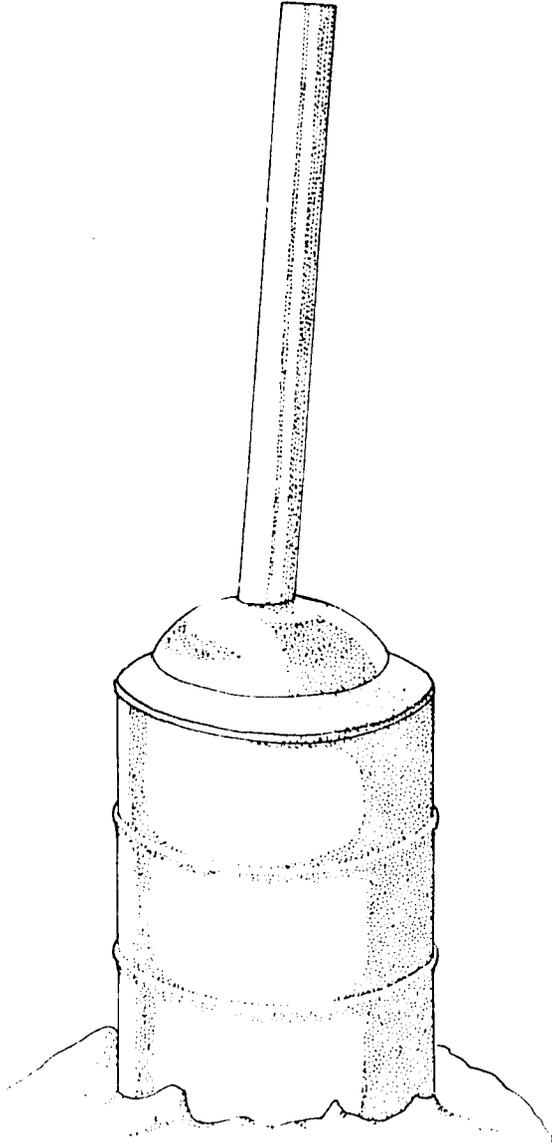
THE KUNI-MBILI COOK-STOVE. This stove uses wood (kuni) much more efficiently than the traditional three-stone fire.



THE KENYA CERAMIC JIKO. The Kenya Ceramic Jiko (pictured on the left) requires only half the charcoal that the traditional jiko uses. It therefore saves the user a considerable amount of money while at the same time reducing the demand for wood from the indigenous forests of Kenya.

Kilns

The kiln programme involves the demonstration of more efficient charcoal production methods. The kilns are also being utilized to monitor and evaluate the best charcoal producing tree species, and various kiln management techniques.



THE PORTABLE CHARCOAL KILN. At Kiuru, portable charcoal kilns have been used extensively for both training and demonstration. These kilns produce much more charcoal per unit of wood than the traditional pit kilns.

Bee-Keeping Programme (Apiculture)

This activity, based at both the centre and sub-centre, was introduced in late 1984 to demonstrate and train farmers on applied agroforestry systems, and modern bee-keeping methods. Six top-bar hives were purchased, two of which were sited at Katun Centre seed orchard and four at the UKA Sub-centre Research and Demonstration Farm.

The honey bee (*Apis mellifera*) is kept primarily for producing honey, and to a lesser extent wax, but it is also very important for pollinating crops.

Management for successful honey production requires abundant flora, knowledge of flowering periods, prevention of swarming by offering sufficient rearing space, ample ventilation, and most important, a close source of water. The above information is taught in the centre's bee-keeping training and demonstration courses.

BEE-KEEPING: One of the benefits of Agroforestry systems of land use.



Fish Farming Programme

This activity, introduced by MOALD, is based at Kituu Centre's two dams.

8000 Tilapia fingerling have been introduced so as to increase the production from the two dams. This affords the farmers access to training and demonstration in yet another agroforestry system, i.e., one with fish as the livestock.

The major topics covered during extension courses in this system are: How to start a fish farm (Range system); fish husbandry simplified, and fish as a source of protein.



THE KITUU CENTRE DAMS. The 2 dams at the Kituu Centre have been stocked with Tilapia and these are being used for training in integrated farm management practices. Pictured is the dam recently built by the project. This dam, together with the smaller old dam has a capacity of over 20 million gallons of water.

Appendix 1

Tree Species Being Produced in the Kitui and Ukai Nurseries

Species	Kitui	Ukai
1. <i>Aberia caffra</i>		X
2. <i>Acacia halocerca</i>	X	
3. <i>Annona squamosa</i>	X	
4. <i>Azadirachta indica</i>	X	
5. <i>Balanites aegyptiaca</i>	X	
6. <i>Bixa orellana</i>	X	
7. <i>Callistemon sp.</i>	X	
8. <i>Calodendrum capense</i>		X
9. <i>Carica papaya</i>	X	
10. <i>Cassia siamea</i>	X	X
11. <i>Cassia spectabilis</i>	X	
12. <i>Casuarina equisetifolia</i>	X	X
13. <i>Citrus spp.</i>	X	X
14. <i>Croton megalocarpus</i>		X
15. <i>Curpressus lusitanica</i>	X	X
16. <i>Delonix regia</i>	X	X
17. <i>Eucalyptus maculata</i>	X	
18. <i>Eucalyptus paniculata</i>		X
19. <i>Eucalyptus saligna</i>	X	
19. <i>Flamingia congesta</i>	X	
21. <i>Gliricidia sepium</i>		X
22. <i>Grevillea robusta</i>	X	
23. <i>Jacaranda mimosifolia</i>		X
24. <i>Leucaena leucocephala</i>	X	X
25. <i>Melia azedarach</i>	X	X
26. <i>Moringa oleifera</i>	X	
27. <i>Morus alba</i>	X	
28. <i>Parkinsonia aculeata</i>	X	
29. <i>Passiflora edulis</i>	X	X
30. <i>Psidium guajava</i>	X	X
31. <i>Schinus molle</i>	X	X
32. <i>Sesbania grandiflora</i>	X	
33. <i>Spathodia nilotica</i>		X

Appendix 2

List of Species in the Seed Orchard's

- | | |
|---|-----------------------------------|
| 1. <i>Aberia caffra</i> | 22. <i>Eucalyptus saligna</i> |
| 2. <i>Acacia albida</i> | 23. <i>Gliricidia sepium</i> |
| 3. <i>Acacia haloserica</i> | 24. <i>Gmelina arborea</i> |
| 4. <i>Acacia gerrardii</i> | 25. <i>Grevillea robusta</i> |
| 5. <i>Acacia saligna</i> | 26. <i>Jacaranda mimosifolia</i> |
| 6. <i>Acrocarpus fraxinifolius</i> | 27. <i>Leucaena leucocephala*</i> |
| 7. <i>Ailanthus altissima*</i> | 28. <i>Macadamia sp.</i> |
| 8. <i>Anacardium occidentale</i> | 29. <i>Maesopsis eminii</i> |
| 9. <i>Azadirachta indica</i> | 30. <i>Melia azedarach*</i> |
| 10. <i>Balanites aegyptiaca</i> | 31. <i>Parkinsonia aculeata</i> |
| 11. <i>Calodendrum capense</i> | 32. <i>Persea americana</i> |
| 12. <i>Cassia spectabilis*</i> | 33. <i>Prosopis chilensis</i> |
| 13. <i>Casuarina equisetifolia*</i> | 34. <i>Prosopis juliflora</i> |
| 14. <i>Citrus limon (Rough Lemon)</i> | 35. <i>Psidium guajava</i> |
| 15. <i>Citrus sinensis (Sweet Orange)</i> | 36. <i>Punica granatum</i> |
| 16. <i>Citrus sp. (Washington naval)</i> | 37. <i>Samanea saman</i> |
| 17. <i>Croton megalocarpus*</i> | 38. <i>Schinus molle</i> |
| 18. <i>Cupressus lusitanica</i> | 39. <i>Sebania grandiflora*</i> |
| 19. <i>Delonix regia</i> | 40. <i>Tamarindus indica</i> |
| 20. <i>Erythrina abyssinica</i> | 41. <i>Tipuana tipu</i> |
| 21. <i>Eucalyptus paniculata</i> | 42. <i>Vitex keniensis</i> |

*Species marked with an asterix are already producing seeds.

Appendix 3**Average Rainfall Figures 1983 & 1984**

YEAR	MONTH	(mm)
1983	JAN.	—
	FEB.	—
	MAR.	—
	APR.	66.9
	MAY	52.3
	JUNE	4.2
	JULY	—
	AUG.	—
	SEPT.	—
	OCT.	—
	NOV.	48.4
	DEC.	82.5
1984	JAN.	85.7
	FEB.	—
	MAR.	—
	APR.	—
	MAY	14.3
	JUNE	—
	JULY	—
	AUG.	—
	SEPT.	—
	OCT.	259.5
	NOV.	249.1
	DEC.	82.5

Appendix 3

Average Rainfall Figures 1985

YEAR	MONTH	(mm)
1985	JAN.	40.3
	FEB.	48.0
	MAR.	60.3
	APR.	371.1
	MAY	35.1
	JUNE	0.6
	JULY	5.4
	AUG.	1.5



**Staff List —
Kitui
Agroforestry
Energy Centre**

C.D.K. Muhia	Centre Manager
Jenny Miller	US PCV Extension Officer — Meru
Terry Severson	US PCV Extension Officer — Machakos
Doral Martin	US PCV Extension Officer — Embu
Laban Nthiga	Centre Foreman
James Ngugi	Ukai Sub-Centre Foreman
Samuel Musyimi	Stores Records Clerk
Bernadetter Munyoki	Centre Typist
Teresia Kamene	Messenger
John Muindi	Driver
James Waithaka	Driver
Paul Munyao	Artisan

**Other
Associated
Staff**

S.C. Ondieki	D.A.O. Kitui
P.G. Macharia	D.F.O. Kitui (till 3-9-85)
David Mbugua	D.F.O. Kitui (since 3-9-85)
P.K. Nderitu	D.A.F.O. Centre Division
C.N. Gitahi	Principal Ukai
Gitonga	C.O. Mwingi Kyuso
S.M. Kiriba	Principal B.L.L.
W. Odera	Principal Multipurpose Training Centre
Father Olary	Pastoral Centre — Thome Wa Akiisto
Munyoki Mukavi	Adult Literacy — Pastoral Centre
J.N. Kinuthia	Soil Water Cons. Officer — Kitui
Waithaka	C.O. Mutomo
Maina	D.A.O. Machakos
Kassimu	Greenbelt Ranger — Kitui
Kaluku	Divisional Soil Cons. Officer — Central
Mugo	Supt. of Prisons — Kitui
Chege	District Culture & Social Services — Kitui
Mwaniki	A.O. Embu
All DEC. Members	Kitui District
D. Kiptugen	Soil and Water Conservation Officer — Machakos

