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ENERGY/DEVELOPMENT INTERNATIONAL (e/di) 62

KENYA RENEWABLE ENERGY DEVELOPMENT PROJECT

POTENTIAL FUELWOOD/AFFORESTATION/AGRO-FORESTRY SPECIES

FOR KENYA

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AMARE GETAHUN

D. S. MUTURI

P. M. WAMAHIU

MINISTRY OF ENERGY
P.O. BOX
NAIROBI

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The views expressed in this document are those of the authors and do not necessarily represent those of the Ministry of Energy nor that of e/di.

POTENTIAL FUELWOOD/AFFORESTATION/AGRO-FORESTRY SPECIES FOR KENYA

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INTRODUCTORY NOTE

USAID is helping fund a three-year Renewable Energy Development Project for Kenya. The Project objectives are, among others:

1. To stimulate development of low cost renewable energy technologies for urban and rural populations.
2. The development of non-conventional sources of Energy, i.e., firewood, charcoal, and
3. Rural afforestation;

The largest project component is the establishment of at least six fuelwood/agroforestry centers, namely:

A. Three in the highlands
   1. Kisii
   2. Kakamega
   3. Eldoret

B. Two in the Uplands Dry Savanna
   4. Ngong (Nairobi)
   5. Machakos (Upland - NW)

C. One in the Semi-arid Lowlands
   6. Kitui

D. One in the Sub-humid Coast
   7. Kilifi

Each center is to include research, demonstration and extension. Each center is expected to screen and evaluate at least 35 woody species suitable for the ecology represented by the center and demonstration sites

attached to each center. A 200,000 seedling production capacity of each center is also expected at the end of the three years.

This list of Potential Fuelwood/Afforestation/Agroforestry species for Kenya represents preliminary effort made by some of the project staff members to identify plant resources and sources for use in the project. An attempt has also been made to regroup the potential species under each of the major environments of Kenya viz a viz the project centers. A general background description of each ecological region is also provided as it relates to agroforestry needs and potentials.

This information is being made available to potential users, especially those involved in tree planting programs in Kenya. Comments on, and reactions to this list will be most welcome.

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ACKNOWLEDGEMENT AND SOURCE OF INFORMATION

This list of potential species and the ecological and other information on each species is based on communications with selected persons, organizations and selected reports.

Persons who have been consulted include:

1. Prof. John Kokwaro, University of Nairobi
2. Mr. Gunnar Poulsen, Beijer Institute, Nairobi
3. Dr. P.K.R. Nair, ICRAF, Nairobi
4. Dr. J. Raintree, ICRAF, Nairobi
5. Ms. Louise Buck, ICRAF/Mazingira Institute, Nairobi
6. Mr. S. Hale, e/di, Washington D.C., USA

Conventional and non-conventional documents from the following organizations and institutions in Kenya have been consulted, namely:

1. MNER (Forest Department)
2. NCCK
3. NCWK
4. ICRAF
5. IDRC
6. Mazingira Institute
7. World Bank/Kenya
8. IDS/University of Nairobi
9. Environment Liaison Center (ELC)
10. KARI (Muguga)

Miscellaneous information regarding tree species contained in documents of the above agencies has been consulted to compile the list, particularly with a view of assessing what is already in Kenya.

An attempt has also been made to identify seed sources, particularly for experimental purposes both within Kenya (K) and outside Kenya (XK). This information, based on each species, is not included here. ICRAF is currently working on this information-base. But in general, the following sources should be considered.

A. WITHIN KENYA

K-0	Kenya Natural Woody Vegetation
K-1	Baobab Farms - Mombasa
K-2	IPAL - Gatab (Marsabit)
K-3	Nginyang (Baringo District)
K-4	Machakos (Katumani)
K-5	MENR (Forestry) - Nairobi
K-6	RAES, MOA - Nairobi
K-7	Ngong - Nairobi
K-8	KARI - Muguga

B OUTSIDE KENYA

XK-1	SETROPA - Holland
XK-2	Indian Forestry - India
XK-3	Israel
XK-4	CSIRO - Australia
XK-5	Bogor - Indonesia
XK-6	USA - California
XK-7	USA - Hawaii
XK-8	Sudan
XK-9	Malawi
XK-10	Zambia
XK-11	IITA, Ibadan - Nigeria
XK-12	FRIN, Ibadan - Nigeria
XK-13	FAO - Rome

CRITERIA USED IN THE SELECTION OF POTENTIAL FUELWOOD/ AFFORESTATION/AGROFORESTRY SPECIES FOR USE IN KENYA

1. GENERAL CRITERIA

The list is made for potential use in Kenya and is largely based on what is available in Kenya. More emphasis has been given to fuelwood and multi-purpose woody species, particularly those with positive relation and interaction with food crops but with a felt-need for fuelwood. Multi-story plant associations (agric) need to be the major thrust of agroforestry systems, particularly in the highlands as land is too scarce a commodity to allow continued allocation of land for mono-culture farming.

In the semi-arid zone where land is not yet limiting resource, a woody component is considered essential in a livestock and crop farming enterprises to effectively use the limited moisture, reduce evaporation, and ameliorate site physical conditions for man and his domestic animals. The introduction of fast-growing woody species, especially leguminous, should be given emphasis.

2. SPECIFIC CRITERIA

Specific criteria used to compile the list of potential species are:

2.1. Ecological adaptability to one or more environment in Kenya.

2.2. Reputed end-use and benefits

(a) (RED) - those more for renewable energy development

(b) (HORT) - horticulture

(c) (TIM) - timber, pole, construction

(d) (FOD) - fodder, browse

(e) (C) - cultivated food and cash crops

(f) (CONS) - soil conservation, site and habitat improvement

(g) (BIOM) - energy and biomass crops

(h) (MULT) - multi-purpose species

2.3. Suitability of species under 2.1. and 2.2. above in fuelwood plantations (woodlots) and/or useful in agroforestry systems of land-use, being suitable for one or more of the following agroforestry models.

Model 1 - multi-story plant associations

Model 2 - alley or zonal (spatial) systems including

(a) alley (strip) cropping

(b) topo-sequence (zonal) agriculture

(c) woodlots or plantations

Model 3 - taungya or modified "shamba" system

(a) planted woody fallow (temporal)

(b) rotations (temporal)

Model 4 - trees in irrigated agriculture

2.4. Habit (form)

(a) (T) large tree

(b) (ST) small tree

(c) (S) shrub

(d) (B) bush

(e) (H) herbaceous perennial

2.5. East of propagation and coppicing characteristics

(a) (S) raised from seedlings

(b) (DS) direct seedlings

(c) (CV) propagated by vegetative means

3. CRITERIA USED FOR SUGGESTED SPECIES FOR THE FOUR MAJOR ENVIRONMENTS (COAST, SEMI-ARID, UPLAND SAVANNA, AND HIGH POTENTIAL HIGHLANDS)

3.1. The principal consideration is ecological adaptability of the species for the natural environment. The felt-needs of the ecological region such as cash income from trees, browse/fodder for livestock and site improvement (shade, moisture, soil fertility) as well as woodfuel production in the upland savannas, and woodfuel production, soil and water conservation in the highlands has been used to modify the list. Finally, the existing land use systems have been considered as the woody element must fit the type of agriculture (including livestock) or compete with.

3.2 Some species that are known to have a wide ecological ampletudes are listed under more than one environment such as Cordia meglocarpa, Cassia siamea, Casuariana equisetifolia, Gmelina arborea, Chinus molle, Cupressus arizonica, Grevillea robusta, etc. Many semi-arid specie could be expected to perform well in the sub-humid and humid uplands and highlands near the equator or at elevations not exceeding 2,400m.

3.3. The ecological regions, and locations within each region, briefly described, and species suggested, is based on the USAID financed, Kenya Renewable Energy Project Development identified Fuelwood/Agro-forestry centers, namely: Kisii, Kakamega, Eldoret, Ngong (Nairobi), Machakos, Kitui, and the Coast (Kilifi). These centers represent four physical environments each with differing potentials, namely:

1. The high potential highlands (Kisii, Kakamega and Eldoret)
2. The medium potential upland savanna (Ngong and N.W. Machakos)
3. The low potential semi-arid zone (Kitui, S.S.E. Machakos)
4. The low to medium potential sub-humid coastal zone (Kilifi).

I. GENERAL LIST OF POTENTIAL FUELWOOD/AFFORESTATION/AGROFORESTRY SPECIES FOR KENYA

1. Aberia caffra
2. Aberia rehgrosa
3. Acacia abyssinica
4. Acacia acuminata
5. Acacia adupondobiom
6. Acacia albida
7. Acacia aneura
8. Acacia arabica
9. Acacia aulocarpa
10. Acacia auricalaeformis
11. Acacia baileyana
12. Acacia besteri
13. Acacia cyanophylla (A. saligna)
14. Acacia cyclops
15. Acacia deabata
16. Acacia decurrens
17. Acacia fornesiana
18. Acacia holosericea
19. Acacia lahai
20. Acacia mangiuin
21. Acacia mearnsii (A. mollisima)
22. Acacia melanoxylon
23. Acacia modesta
24. Acacia nilotica
25. Acacia paraecox
26. Acacia parkinsinia
27. Acacia pellacaultra
28. Acacia plectorcarpa
29. Acacia podalyriifolia
30. Acacia polyacantha
31. Acacia senegal
32. Acacia seyal
33. Acacia spectabilis
34. Acacia raddiana
35. Acacia tortilis (radiata)

Typist: Learn [illegible] Jap between Genera je between Acacia and Acokanthera etc [illegible]

...../2

36. Acacia tronida
37. Acacia turnida
38. Acacia xanthophloea
39. Acacia zanzibarica
40 Acokanthera fnesiorium
41. Acokanthera shimperi
42. Adansonia digitata
43. Adhatoda viscosa
44. Afzelia cuanzensis
45. Ailanthus excelsa
46. Ailanthus glandulosa
47. Albizia chinensis
48. Albezia cariaria
49. Albizia falcataria
50. Albizia gommifera
51. Albizia julibrissin
52. Albizia lebbeck
53. Albizia procara
54. Albizia stipulata
55. Albhornea cordifolia
56. Alnus jorulensis
57. Alnus rubra
58. Anona squamosa
59. Anthonata marcrophylla
60. Apodytes dimidiata
61.

to be Continued

II THE MAJOR ENVIRONMENTS AND SUGGESTED SPECIES.

A. HIGH POTENTIAL HIGHLANDS.

KISII -CENTER - 1

KAKAMEGA - CENTER - 2

ELDORET -CENTER - 3

DEVELOPMENT POTENTIAL AND CONSTRAINES

GENERAL FEATURES OF THE KENYAN HIGHLANDS

1.1. At least three centers are planned to be sited in the highlands. The Highlands are described by the general term, "High Potential Highlands" estimated at 9% of Kenya's landmass or 53,000km^2 (Hosier,1981) though they show wide range of conditons and development opportunities. These differences will be reflected in the species choice and the agro-forestry model to be used at each Center.

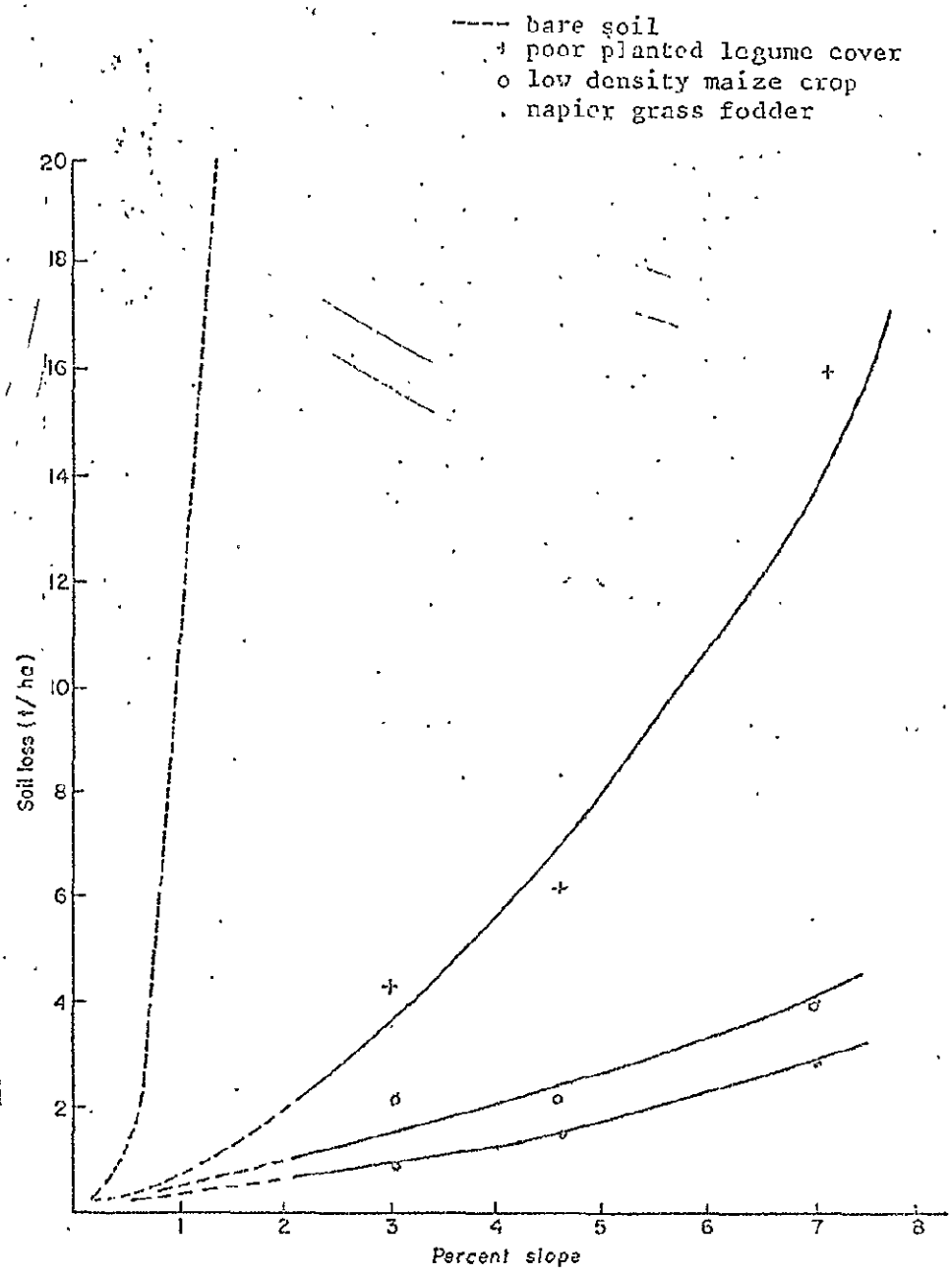
1.2. In general, the highlands are said to be the hardest hit by fuelwood shortage but they also represent natural environments (soil and moisture) with the highest potential for annual plant biomass production (i.e.15-25m^3/ha/yr as compared to under 4m^3/ha/yr in the semi-arid zone). This fuelwood shortage is due to a) high density population dependant on fuelwood, b) natural forest and woody vegetation which was the traditional source, largely replaced by food and cash crop agriculture, (i.e.maize, wheat, tea, coffee, etc.), dairying, and by industrial forest plantation, c) the lack of native tradition of planting fuelwood, and d) relative scarcity of land and labour for fuelwood planting and maintenance.

1.3. Local topography of the highlands is typically gentley undulating to steep slopes where average hillslope gradients often range from 10% to 20%. The highlands also receive high annual rainfall. Thus, both the high rainfall and steep local topography have important bearing on soil erosion depending on type of land use practices. Forested catchments loose soil at the rate of 0.2-0.3 tons/ha/yr while soil

TABLE 6: HYDROLOGICAL CYCLE IN NATURAL AND DISINTEGRATED ECOSYSTEM (After Egunjobi, 1980)

HYDROLOGICAL EVENTS	UNDER FOREST %		BARE MOUNTAIN %	
	LOSS	GAIN	LOSS	GAIN
ABSORBED BY (TREE) VEGETATION	–	25	–	–
EVAPORATION/EVAPOTRANSPIRATION	15	–	40	–
SOIL INFILTRATION	–	25	–	5
SURFACE RUNOFF	25	–	50	–
TOTAL	40	50	90	5

Figure 6. Rate of soil-loss at different degrees of slopes and vegetation cover.



Source: Agriculture and Environment Vol 4, 1978 (Beels)

loss from agricultural lands (i.e. eastern side of Mt. Kenya) ranges between 20 and 40 tons/ha/yr (Dunne,et,al,1981),Fig 1 shows typical rate of soil-loss at different degrees of slopes and vegetation cover, illustrating the effectiveness of permanent ground cover.

1.4. The most valuable crop that can be harvested from the highlands is WATER (ICIPE, 1979) to feed the perennial rivers such as the Tana river which are the life-blood of the arid and semi-arid zones of Kenya and where hydro-power is also derived from. Land-use and rural settlement and the building of infrastructures (roads, track etc) must consider this important role of the highlands. Permanent ground cover must be an essential feature to consider. Fig 2 illustrates the hydrological balance sheet from a highland zone (Getahun,1981).

1.5. The highlands, not only are they heavily populated, but outside urban and pre-urban centers, they typically have a dispersed homestead pattern of settlement unlike the arid and semi-arid zones which typically have village patterns. Therefore, village or community patterned agro-forestry models may not be applicable in the highlands.

TRADITIONAL AGRO-FORESTRY/FUELWOOD PRACTICES IN THE KENYAN HIGHLANDS.

1.2.1. The tradition of growing both subsistance and cash crops is strong in the highlands where nearly all of which are crop commodities (tea, coffee, pyrethrum, maize,etc). The rate of adoption of these new crops such as hybrid maize has been rapid largely due to good market prices and development policy. Farmers had been eager to go into coffee and tea ~~growing~~ which normally take more than five years for the first harvest, without government help. Similarly farmers have taken dairying and limited sheep [illegible], based on modern or improved breeds. These enterprises approach monoculture unlike the growing of more traditional food crops (maize, beans, and bananas) the latter grown in mixtures.

1.2.2. Opportunities exist for irrigated tree crop agriculture including the use of one of largest fresh water lakes, L.Victoria. The use of seasonally wet bottomlands is also mimimal, Now Both should increase, particularly to grow trees, maximum use could be made if the incoming radiation (photosynthetic energy potential) if irrigation and lands with high water table are utilized.

1.2.3 There is hardly any tradition of planting fuelwood. The main source of fuelwood have been the gazzetted forests as they are converted to softwood industrial plantations under the "SHAMBA" System and from private plots, trees planted near homesteads such as Eucalyptus Spp, trees planted as crop field boundary plants (Cordia megalocarpa, Cupressus, Grevillea), Black Wattle), which are prunned or pollarded and serve as domestic fuelwood sources.

1.2.4. Some fruit trees such as mango, avocado, loquat are planted near the homes and these occasionally serve as souces of fuelwood, with age, as well as pruned branched from coffee farms.

1.2.5. Some established pastures such as Napier grass (Pennisetum purpureum) often have scattered Croton (Planted or retainded) that may serve, in times of need, as fuelwood and construction sources.

1.2.6. The most common topo-sequence agricultural land-use consists of:

(a) Bottomlands (foot hill) -maize and banana with some vegetable crops

(b) Mid-Slope -Coffee mixed with Grevillea, Beans and maize or devoted for tea growing.

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(c) Hill Crest - homestead with planted fruit trees, Grevillea, Croton, Black Wattle and some live hedges (i.e. Euphorbia, Lantana, etc)

.2.7. Black Wattle (Acacia mearnsii) plantations under a 10-year rotation such as in Eldoret has been successful and has led to Blackwattle to be grown by small holder farmers, largely to sell as poles.

.2.8. B . A. T's practices of requiring tobacco growers to-be to plant woodlots for later use to cure tobacco is a positive experience to potentially wider practice of woodfuel establishment. The likelihood of energy (tree) crops competing with coffee or tea may not be impossible.

.3. THE PLACE AND ROLE OF FUELWOOD/AGRO-FORESTRY CENTERS IN HIGHLANDS.

.3.1 Food, cash (from sale of cash crops) and/or dairying) and woodfuel needs will continue to increase in the highlands. Thus, the pressure for land will continue to increase. Economic returns to land and labour are probably higher from perennial cash crops (tea, coffee) and darying than from traditional food crops. These could be made even more profitable if interrupted with food crops, hence the need for agro-forestry system of land-use, but making sure that farm labour requirement are not increased.

.3.2. Incoming radiation (for photosynthesis) and moisture (rainfall) are sufficient to support more than one layer of crop on a given land. Tree forms can effectively bridge the dry-season gap by utilizing sub-surface moisture and mineral nutrients and can contribute to site improvement. Stratification of several compatible layers appears to be possible. Both food and tree crop production as well as livestock production can be accomodated under this multi-story agriculture system,

particularly when prunning and/or pollarding is done before planting of annual crops. Croton magalocarpa is one such (native) tree species that may prove to meet these conditons, particularly when planted in a row-system.

1.3.3. More aggressive, and fast growing woody species, such as Eucalyptus Spp. Cassia siamea may need to be planted into dense woodlots groves without attempting to undersaw or make provision for grazing under them. These could be planted near the homes, away from the crop and pasture fields. The harvesting cycle of these woodlots needs to be as short as five years or less instead of 7-10 years or more as is the case for blackwattle and Eucalyptus Spp, if grown for marketing the production beyond family needs if cash income is considered. Fast growing species of Leucaena, Sesbania, and Mimosa can reach harvestable age every three years or less and can be intercropped with food crops and, where, with more frequent cutting (2-5 times/yrs), they can also serve as fertilizer sources to the food crop system, there-by reducing or displacing the need to buy inorganic fertilizers.

1.3.4. Despite the long experience of forestry research in the highlands, information on fast growing species, outside those for inudustrial forestry and ornamental use, is lacking. Much effort needs to be expended to quickly generate such information.

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2. FUELWOOD/AFFORESTATION/AGRO-FORESTRY SPECIES. 1/

		Form	PROP	MODEL	END-USE
1.	Aberia caffra	S	DS	2.3	HORT,CONS
2.	Acacia dealbata	T	DS.S	1.2.3	RED,CONS.
3.	Acacia decurrens	T	DS.S	1.2.3	RED,CONS,FOD
4.	Acacia mearnsii	ST	DS,	1.2.3	RED,TIM,CONS, MULTI.
5.	Ailanthus grandulosa				
6.	Ailanthus excelsa				
7.	Albizia falacataria	T	DS	1.2.3.	RED,TIM CONS.
8.	Arucaria angustifo--lia	T	S	1	RED,CONS
9.	Arucaria calamnaris	T	S	1	TIM
10.	Arucaria cunninghamii	T	S	1	TIM
11.	Arundomarea alpina	H	CV	2,3,	TIM,CONS
12.	Bridelia micrantha	T			RED
13.	Budleia spp.	S	CV	1,2,3	RED
14.	Calliandra calothy--rsus	T	DS	1,2,3	RED,CONS
15.	Caesalpina decapetala	B	DS	1.2.3	CONS,RED
16.	Callistris Spp.				
17.	Cassis siamea	T	DS,S	1.2.3	RED,TIM
18.	Casuarina equiseti--folia	T	/S	1.2.3	RED,TIM
19.	Catha edulis	B	DS,CV	1.2.3	C
20.	Cedrela mexicana	T		2.3.	RED,TIM
21.	Celtis africana	T	S	1.2.	RED,TIM
22.	Coffea arabica	S	S	2	C
23.	Crotalaria SPP	B	DS	2	CONS
24.	Cordia abyssinia	T	S	1.2.3	TIM,RED
25.	Cordia alliodora	T	S	1.2.3	TIM,RED
26.	Croton marcostachys	T	S	1.2.3.	TIM,RED
27.	Croton megalocarpa	T	DS	1.2.3.	RED,TIM
28.	Cupressus arizonia	T	S	1.2.3.	TIM,RED
29.	Cupressus lasitanica	T	S	1.2.3.	TIM,RED
30.	Dovyalis macrocalyx	ST	DS,S	1.2.3.	RED
31.	Erythrina poepoigiana	T	VC	1.2.3.	CONS

	FORM	PROP	MODEL	END USE.
32. Erythrina excelsa	T	VC	1.2.3.	Cons
33. Erioborium japonic--um	ST	DS	1.2.3.	HOTT,RED
34. Eucalyptus camal--dulensis	T	S	2.3.	RED,TIM
35. Eucalyptus citrio--dora	T	S	2.3.	RED,TIM
36. Eucalyptus cladoclyx	T	S	2.3.	RED,TIM
37. Eucalyptus deglupta	T	S	2.3.	RED,TIM
38. Eucalyptus gobulus	T	S	2.3.	RED,TIM
39 Eucalyptus grandis	T	S	2.3	RED,TIM
40. Eucalyptus maide--nii	T	S	2.3.	RED,TIM
41. Eucalyptus saligna	T	S	2.3.	RED,TIM
42. Eucalyptus viminalis	T	S	2.3.	RED,TIM
43. Ficus carica	ST	DS	1.2.	HORT
44. Flamingia congesta	B	DS	2.3.	COVS
45. Gliricidia sepium	ST	DS,VC	1.2.3	CONS,RED
46. Gmelina arborea	T	S	1.2.3.	TIM,RED
47. Grevillea robusta	T	S	1.2.3.	TIM,RED
48. Hakea saligna				
49. Jacaranda mimosi--folia	T	S	2	HORT,RED
50. Lantana camara	S	VC	2	RED,CONS
51. Leucaena esculenta	ST	DS	2.3.	RED,FOO,MULT
52. Melia spp.	-	DS	1.2.3.	RED
53. Maesopsis eminii				
54. Mangifera indica	T	DS,S	1.2.3.	HORT,RED
55. Markhamia hildebra--ndtii	T		1.2.3.	RED,HORT
56. Markjamia platucalyx	T		1.2.3.	RED
57. Markhamia tipa				RED
58. Milletia dura	ST	DS,S	1.2.3.	RED
59. Mimosa scabrella	ST	DS	1.2.3	RED,COTC
60. Morus alba	B	VC	2.3.	HORT
61. Olea africana	T	DS,S	1.2.3	TIM,RED
62. Pennisetum purpureum	T	VC	2.3.	FOD.CONS.

	FORM	PROP	DODEL	END USE
63. Persea americana	T	DS	1.2.3.	HORT
64. Pinus patula	T	S	1.2.3.	TIM,RED
65. Pinus radiata	T	S	1.2.3.	TIM,RED
66. Populus deli--toides	ST	VC	1.2.3.	RED
67. Polyscias kukugensis	GT			RED
68. Pterocarpus Spp.	T	S	1.2.3.	RED
69. Punica granatum	S	DS	1.2.3.	HORT
70. Pygium africanum	T		1.2.3.	TIM,RED
71. Rhus natalensis	ST	DS		RED
72. Samanea saman	T	DS,VC	1.2.3	RED,CONS.
73. Schinus molle	T	DS,S	1.2.3.	RED
74. Spathodea campa--nulata	T		1.2.3	RED,TIM
75. Thea sinensis	B	D	1.2.3.	HORT,C
76. Tipuana tipa. (T. speciosa)	T			RED
77. Trama orientalis				RED
78. Typha spp.	H	VC	2	BIOM
79. Vitex keniensis	T	S	1.2.3	TIM,RED

B. UPLAND SAVANAS :

THE NGONG, (NAIROBI). CENTER.- 4

11. DEVELOPMENT POTENTIALS AND CONSTRAINTS

1.1 General Situations

1.1.1. Both ecological conditions and demand and consumption of fuelwood in the Central Province and Uplands Machakos justifies the establishment of one Fuelwood/Agro-forestry Center, though this was not initially specified in the Project Document.

1.1.2 Ecologically, Ngong represents upland savanas with medium to low agricultural potentials, largely due to edaphic (heavy black cotton soils) and rainfall. As a consequence, agricultural crop farming is not intense nor signigicant, despite the excellent market opportunities from Nairobi and other nearby urban centers. Livestock production is, however important.

1.2 IMPORTANCE OF FUELWOOD PLANTATIONS AND CONSUMPTION

1.2.1 Currently, 30% (or 6,000ha.) of the total fuelwood plantations in Kenya are centered around Nairobi and Machakos district and the woodlands of Ngong area itself is currently under heavy exploitation for charcoal making.

1.2.2 Nairobi and Central Province account for 20% of the total fuelwood consumption and Nairobi alone accounts for more than 45% of the charcoal consumption.

2.3 Nairobi itself acts and serves as the leading center for tree seedling distribution to other parts of the Republic,

SPECIES	HABIT	PROP. METHOD	AGRO-FORESTRY MODELS	PRIMARY USE
28. Tristania coniferata	Tree	Seedling	2,3	Fuelwood, Pole, timber
× 29. Tipuana tipu (T. speciosa)	Tree	Seed	1,2,3	Fuelwood
30. Vernonia amygdalina	Shrub	Seed	1,2,3	Food
31. "Cape chestnut"				
× 32. Prosopis cineraria				
33. Gliricidia sepium				

IV. POTENTIAL FUELWOOD/AGRO-FORESTRY SPECIES FOR UPLANDS SAVANNA (NGON

	SPECIES	HABIT	PROPAGATION METHOD	AGRO-FORESTRY MODEL	PRIMARY USES
x 1.	Acacea mearnsi	Tree	Seed/seedling	2,3	Pole, tannin, fuelwood
2.	Acacia melanoxylon	Tree	Seed/seedling		Pole, fuelwo soil cons.
3.	Acacia cyanophylla	Tree	Seed	1,2,3	Fuel, feed, soil con
4.	Albizia Chinensis	Tree	Seed/seedling		Fuelwood, soi cons.
	Balanites aegypliaca	Tree	Seed	1,2,3	Fuelwood,
5.	~~Albizia~~	~~Tree~~			
x 6.	Cassia siamea	Tree	Seedling, seed	1,2,3	Pole, fuelwo soil cons.
	Calodendrum capense	Tree			→ Timber
7.	Casuarina cunninghamii	Tree	Seedling	2,3	Fuelwood
x 8.	Casuarina equisitifolia	Tree	Seedling	2,3	Fuelwood, pol
9.	Cedrella toona	Tree	Seedling		
10.	Cedrella ~~mexicana~~ odorata	Tree	Seedling		
11.	Ceratonia siligue	Tree	Seed		
12.	Croton Macrostachys	Tree	Seed/seedling	1,2,3	Timber, pole, fuelwood
x 13.	Croton meglocarpa	Tree	Seed, seedling	1,2,3	" "
x 14.	Eucalyptus camaldulensis	Tree	Seedling	2	Pole, fuelwo
15.	Eucalyptus cladocalyx	Tree	"	2	" "
16.	Eucalyptus grandis	Tree	"	2	" "
x 17.	Eucalyptus ~~sabigna~~ microtheca	Tree	"	2	" "
18.	Erythrina spp	Tree	Seed, cutting	1,2,3	Soil cons
19.	Gmelina arborea	Tree	Seedling	2,3	Pulp, pole, timber, fuel
x 20.	Grevillea robusta	Tree	Seedling	1,2,3	Timber, pole fuelwood
x 21.	Leucaena esculenta	Tree-shrub	seed, seedling	2,3	Browse, fuel od, soil cons
x 22.	Leucaena leucocephala	Tree-shrub	seed, seedling	2,3	Browse, fuel ood, soil c
	Lonchocarpus eriocalyx	Tree	—	—	multi-purpose
23.	Melia volkensi	Tree	seedling		
24.	Melia azadrichta	Tree	seed, seedling		
25.	Schinus molle	Tree	seedling	1,2	Fuelwood
x 26.	Sesbania grandiflora	Tree-shrub	seed, seedling	1,2,3	Pole, fuelwo feed, feed
x 27	Sumnea simon	Tree	Seed, cutting		
27.	Spathodia campanulata		Seed, root seedlings	1,2	[illegible]

x ~~more~~ potentially more important species

...../3

C. SEMIARID -ZONE.
KITUI AND LOWLAND MACHAKOS CENTERS. 5 & 6

DEVELOPMENT POTENTIALS AND CONSTRAINTS.

1.1. General

1.1.1. Two "Centers" are being planned, one at KATUMANI(MACHAKOS) and the other at KITUI. A common list of potential species is made only to reflect their ecological similarities though the two 'Centers" represent differing Socio-ecomomic conditions and final species choice will need to consider these differences.

1.2 KATUMANI (MACHAKOS)

1.2.1 Agro-ecologically

(a) Local topography - dissected with rolling hills and valleys with dry river beds

(b) Soils - generally sandy soils and murram dominate but vertisols are not uncommon

(c) Climate- semi-arid but with more bi-model distribution

(d) Natural Vegetation - Acacia woodland, but much altered

(e) Dominant land use: dryland crop farming and livestock -land now much degraded as a result.

1.2.2. FELT -NEEDS AND PROBLEMS TO BE SOLVED.

(a) Improved or increase tree cover, especially on slopes and hill crest (top) to reduce soil and water erosion.

(b) Increased browse and fodder production to reduce grazing and tree lopping pressures.

(c) Increased fuelwood production to reduce the acute local firewood shortage where more than 65% of the urban population is now said to use charcoal due to local wood shortages

(d) More production of horticultural and multi-purpose (tree) crops to generate more cash income and improve local diets.

(e) Rural cash and income need to be improved using agro-forestry systems of land-use.

~~KENYA - ARID & SEMI-ARID ZONES~~

2. POTENTIAL FUELWOOD/AGRO-FORESTRY SPECIES (KITUI & ~~MACHAKOS~~ MACHAKOS)

	SPECIES	HABIT	PROPAGATION METHOD	AGROFORESTRY MODEL	PRIMARY END-USE
1.	Acacia acriculiformis	~~Tree~~ T	~~seedling~~ S	1,2,3	RED, Con
2.	Acacia albida	~~Tree~~ T	~~seedling~~ S	1,2,3	RED, FOD, Con
3.	Acacia cyanophylla	~~Tree~~ T	~~seed~~ DS	1,2,3	RED, [illegible]
4.	Acacia parkinsonia	~~Tree~~ T	~~seedling~~ S	1,2,3	RED
5.	Acacia saligna	~~Tree~~ T	~~seedling~~ S	1,2,3	RED
	Acacia cyclops				
6.	Acacia seyal	~~Tree~~ T	~~seedling~~ S	1,2,3	RED
	Acacia raddiana				
7.	Acacia "Nucewa"	~~Tree~~ T	~~seed, seedling~~ DS S	1,2,3	RED
	Acacia torhilis				
8.	Acacia arabica	~~Tree~~ T		1,2,3	FOD TIM ~~Fed~~
	Acacia nilotica				
9.	Anacardium occidentali	~~Tree~~ T	Ds,	1,2	HORT, RED, CON
	Albizia lebbek				
10.	Alchornea cardifolia	S	Ds, Vc	2	CONS, ~~Red~~ RED
11.	Atriplex	–	DS	2	FOD, Cons
12.	Arthocarpus integrifer- (Artocarpus)	T	Ds, Vc.	1,2	Hort, Fod
13.	Azadiracha indica	~~St~~ ST	Ds	1,2	Red, Mult
14.	Balanitu aegyptiaca	~~St~~ ST	Vc.	1,2,3	Red, Fod
15.	Boswellia spp	~~St~~ ST	Vc	1,2,3	Red, C.
16.	Bauhinea sp.	~~St~~ ST	S	1,2,3	Red, Cons
17.	Cajanus cajan	S	Ds	1,2,3	C, Fod
18.	Callitris robusta	T			
19.	Callitris hugelii				
20.	Cassia sianea	T	S, DS	1,2,3	Fod, Tim, Co
	Casuarina cristata	T	S		
21.	Casuarina cunninghamiana	T	S	1,2,3	Red, Tim
	Casuarina stricta	T	S		
22.	Casuarina equisetifolia	T	S	1,2,3	Red, Tim
	Casuarina glauca	T	S		
23.	Cedrela [illegible]dorata	T	S	1,2,3	
24.	Ceratonia siligna	T		1,2,3	[illegible]
25.	Cambretus spp.	T	S	1,2,3	[illegible]
26.	Cordia africana	T	S; B	1,2,3	[illegible]
	[illegible]	S B			MULT
	[illegible]	T	S		TIM, RED

1.3 KITUI

1.3.1. Agro-Ecologically.

(a) Local topography - Undalating to flat lands

(b) Soils - variable, mostly sandy

(c) Climate- semi-arid with moistures index -10 to 30

(d) Natural Vegetation - bush to dry woodland

(e) Dominant land use- livestock production with some dry-land crop farming and fuelwood exploitation as well as large gazzetted forests.

1.3.2 Socio-economically.

(a) Firewood gathering and charcoal making relatively important, particularly as a source of cash income

(b) current level of fuelwood consumption considered to be low

(c) More trend of villagization and pre-urbanization with a corresponding increase in land adjudication (privatization)

(d) Area often food-deficiet..

1.3.3 FELT -NEEDS AND PROBLEMS TO BE SOLVED.

(a) Food production priorities will intensify causing a corrosponding depletion of the tree cover and causing ecological degradation

(b) Development infrastructures such as feeder roads and planned settlenents with its accompanied sedentarization will result in more exploitation of fuelwoods

(c) Livestock production will continue to intensify causing overgrazing

(d) Effort must be made therefore

1) to develop more village woodlots

2) replace the existing gazzetted native forests (wood--land) (should 40,000 ha by 5 [illegible] time more productive species such as Eucalyptus, Cassia, Grevillea, etc,

3) Plant more browse and fodder banks for livestock production.

4) Plant more horticultural and multi-purpose trees for more cash income and to improve [illegible] [illegible]

...../3

~~more cash income and to improve food diets.~~ (SUGAR BELT)

D. THE SUB-HUMID AND LOWLAND LAKE BASIN COASTAL ZONES. - 7

1. DEVELOPMENT POTENTIAL AND CONSTRINTS.

1.1. GENERAL DESCRIPTION.

1.1. The Coastal Strip is a Dist in rict zone ecologically and to some extent, agriculturally. The center for the coast will thus be comprehensive.

1.1.2 Ecologically, the coast has a hot sub-humid to semi-arid climate with wood land and dry forests. Mangrove woodlands are also common, which are currently under active exploitation for charcoal. The soils are largely poor and sandy. Its agro-ecological potential is medium to low.

1.1.3 Agriculturally, both crop farming and livestock is significient. Tree crop plantation (Coconut, oil palm, mecedamia nut, cashew nuts, citrus, etc) is also important, often intercropped with cassava, maize, and sim-sim crops.

1.1.4 Socio-economically, the coast is undergoing increased villagization, pre-urbanization and urbanization. Area has a relatively high rates of fuelwood consumption and is the point of export of charcoal and poles, thus with fuelwood shortage. Development infrastructures are rapidly developing and it has been a Special Rural Development Project region in the 1970-74 and 1974-78 National Five Year Plan Periods.

1.2. THE FELT -NEEDS AND PROBLEMS TO OVERCOME.

1.2.1 Traditional Agricultural activities (food crops, ~~tree~~, tree crops, and livestock production) will intensify causing ecological instability.

...../2.

1.2.2. Fuelwood exploitation will continue to accelerate thus aggravating the ecological balance.

1.2.3 Population increases will be fast with a corresponding demand for food and fuelwood.

1.2.4 Development efforts must therefore include:-

(a) Increased horticultural production
(b) Fuelwood plantations with or without agricultural food crops
(c) Browse and fooder crop,
(d) Soil and habitat improving species (including afforestation)
(e) Energy crops, including hydrocarbons,
(f) Existing Plantations i.e. coconut, oil palm, cashewnuts to include more efforts to intercrop ~~food~~ food crops and grazing.

FUELWOOD/AFFORESTATION/

2. POTENTIAL AGROFORESTRY SPECIES - KENYA COAST & LAKE BASIN

1.	Acacia arabica	T	S	1,2,3	Red
2.	Acacia auriculaeformis	T	S	1,2,3	Red
3.	Acacia falcataria	T	Sd,S	1,2,3	Red,Con
4.	Acacia cyanophylla(salipna)	T	S,Ds	1,2,3	Red
	Acacia cyclops	T	S,DS	1,2,3	RED
5.	Acioa barterii (direct seeding)	S	Ds	2,3	Red, Con
6.	Anacardium occidentalis	T	Ds	1,2	Hort, Red
7.	Artocarpus integrifolia	T	Ds,Cv	1,2	Hort
8.	Adathoda viscosa	B			Red
9.	Alchornea cordifolia	S	Ds	2,3	Con, Red
10.	Anthonatha macrophylla	S	Ds	1,2,3	Con, Red
11.	Azadirchata indica	St	S	1,2	MULT
	Calliandra calothyrsus				
12.	Callitris	T	DS,	2,3	RED, CONS
13.	Callitris hugelii				
14.	Cassia siamea	T	S	1,2,3	Red, Con
15.	Cassuarina equisetifolia	T	S	1,2,3	Red, Con
	Casuarina glauca	T	S	1,2,3	RED, CON
16.	Cassuarina cristata	T	S	1,2,3	Red, Con
	Casuarina decaisneana	T	S	1,2,3	RED, CONS.
17.	Albizia falcataria	T	S,Ds	1,2,3	Red, Con
18.	Bombax	T	S, DS	1 2	HORT, C
19.	Cocus nucifera	T	Ds, S	1	Hort
20.	Ceiba pentandria	T	S	1	Hort
21.	Calliandra collothyraus	T	S		Red
22.	Cedrela odorata	T	S		Red
23.	Cedrela toona	T	S		Red
24.	Croton megalocarpa	T	DS	1,2,3	Red, Tim
	Cupressus sp. arizonica	T	S	1 2	RED, TIM
25.	Cyperus papyrus	Hob	Vc	4	Biomas
26.	Cordia alliodora	T	S	1,2,3	Red, [illegible]
27.	Dalbergia sissoo	ST	S	1,2,3	Red, [illegible]
28.	Dodonea viscosa	[illegible]	[illegible],S	2,3	Con,Red
29.	[illegible]	T	DS,S	1,3	Hort
30.	Erythrina [illegible]	T	Cv	1,2,3	Con

31.	Eriobotrium japonicum	ST	DS	1,2	Hort
32.	Eucalyptus spp	T	S	2,3	Red
33.	Ficus sp.		CV,S	1,2	
34.	Flemingia congesta (C. macrophylla)	B	DS,S	2,3	Con
35.	Gliricidia sepium	ST	CV,DS	2,3	Con, Red
	Gmelina arborea	ST		2,3	RED, TIM,
36.	Moila azadarach	ST	DS	1,2	Red, Hort
37.	Moringa oleifera	S	DS	1,2	Hort
38.	Napoliana imperialis	S	DS	1,2,3	Red, Con
39.	Leucaena leucocephala K-8	~~Red~~ S	DS	2,3	Red, Fed, Con
40.	" " "Cunninghamiana	S	DS	2,3	" " "
41.	" " " Peru	S	DS	2,3	" " "
42.	Lonchocarpus criocalyx				
43.	Macadamia ternifolia	ST	DS,S	1,2	Hort
44.	Mangifera indica	T	S	1,2	Hort, Red
45.	Morus indica	B	CV	2	Hort, Con
	Muntingia calabura	ST	CV, DS	2,3	Red.
46.	Opuntia ficus-indica	B	CV	2	Red, Con
47.	Persea americana	T	S	1,2	Hort
48.	~~Pinus caribaea~~	T	S	2,3	TIM, RED ~~Red~~
	Pinus caribaea				
49.	Populus deltoides	T	CV	1,2	RED
50.	Prosopis spp.	S	S,DS	1,2,3	Red, Con
51.	Psidium guajava	ST	S	1,2,3	Hort, Red
52.	Pterocarpus spp.	T		1,2	Hort, Red, Con
	Punica granatum	ST	DS,	1 2 3	HORT
53.	Schinus molle	T		1,2	Red
	Sesbania bispinosa (S. aculeata)	ST	DS, CV	1,2,3	
54.	Sesbania grandiflora	ST, S	DS, CV	1,2,3	Red
	~~Sesbania sesban~~	~~T~~	~~CV, DS~~	~~1 2 3~~	~~Red, Con~~
55.	Tamarix gallica	T	CV	1,2	Red
56.	Terminalia catappa	T	S	1,2,3	Red, HORT
57.	Tipuana tipu	T	S	1,2,3	Red
58.	[illegible]	T	CV, DS	1,2,3	[illegible]
59.	Tamarindus indica	T	DS	1,2	[illegible]
	Trema guineensis (T. orientalis)	ST	CV	[illegible]	[illegible]
60.	[illegible]	~~S~~ H	CV	3	[illegible]
61.	Typha angustifolia	~~S~~ H	CV	3	Blums

III FUELWOOD/AGRO-FORESTRY CENTERS PROGRAMS DESIGNS

A COMMON PROGRAM AREAS OF EACH CENTER

1. A Seed acquisition
   (a) From local (Kenya) sources
   (b) From Imported
   (c) From seed Orchards developed by the Center i.e., Leucaena, Sesbania, Flamingia Alchornea, Gliricidia, etc which start yelding seed within 18 months from planting)

2. Screening and evaluation of potential species (atleast 35 speci-es/center)

3. Establishment and maintenance of seed Orchards for programm under A, above.
   ~~The seed orchards are derived from the species trial nurseries, B. above.~~

4. Seedling production (nursery operation) with a 200,000 seedlings capacity/center.

5. Research demonstration, and extension on agro-forestry systems and models, namely:-
   (a) model 1 - multi-story plant association
   (b) model 2 - alley or zonal systems including .
      (1) alley (strip) intercropping
      (2) Toposequence (zonal) farming
      (3) Plantations/Woodlots
   (c) Model 3 -Taungya or Shama system
      (1) Planted woody fallows
      (2) Woody fallow-crop xotations
   (d) model 4 - Trees in irrigated agric. (see B for more details)

6. Seed and seedling distribution and extension
   (a) assist afforestation efforts
   (b) assist woodlots and fuelwood production efforts.

7. Training and technical assistance
   (a) Nursery development and management practice
   (b) Post-planting assistance
   (c) Public educational material (newsletter, information documents and teaching materials.

8. Monitoring and evaluation

B. BASE DESIGN OF THE RESEARCH AND DEMONSTRATION PLOTS

1. GENERAL.

Each CENTER is being located at existing (government)nursery and is adjacent or at close proximity with an agricultural training institutions such as Farmers' Training Centers so as to facilitate the training and extension effort and reduce nursery operations costs. Each Center has 5 conventional and 10 agro-forestry demonstration plots, sited to facilitate farmers access to them. The Centers in the upland savana, semi@arid , and coastal zones will be established first and followed by those in the High Potential Highlands.

The nursery operation and the research and demonstration at the center will serve the training programes and detailed information will be collected to facilitate evaluation and monitoring of the development project.

2 DESIGN OF THE RESEARCH TRIALS AND DEMONSTRATION

An attempt has been made to use one basic experimental design for all the Centers both for the species screening trials and for the rsearch and demonstration on agro-forestry systems(models). The experimental design is a continuous function design modified from Bleasdall(1967). The design takes into account and accomodates differences in

(a) Topographic situations(flat, undulating, [illegible]
(b) Plant forms (bush, shrub, tree)
(c) Hand labor or mechanized agric.operations.
(d) Positive or negative relation of tree [illegible]

with annual food crops.

(e) The food crop and/or livestock component is kept constant with only the tree component being variable in both space and time (spatial and temporal)

(f) Nearly all of the agro-forestry models (described above) are in part accomodated by the design.

(g) Cost effectiveness (land and labor or capital cost requirements are kept to the minimum)

2.2 FUELWOOD/AGRO-FORESTRY EXPERIMENTAL TRIAL AND DEMONSTRATION

Each woody species will be planted in modules with continuous function where each species will have 12 modules (planting arrangements) as shown in Fig 2 and 8 planting densities as shown in Fig. 3

Fig. 3 and 4 show the basic planting designs to be used for the long-term experiment and demonstration.

Fig. 2 Fuel-Wood/Agro-Forestry Experimental trials and Demonstration planting modules.

Line density Row width	0.5m	1m	2m	3m
2m	2A $1m^2$	2B $2m^2$	2C $4m^2$	2D $6m^2$
4m	4A $2m^2$	4B $4m^2$	4C $8m^2$	4D $12m^2$
6m	6A $3m^2$	6B $6m^2$	6C $12m^2$	6D $18m^2$

Fig. 3 Fuelwood/Agro-Forestry Experimental trial and demonstration planting densities and plant arrangement (modules).

Densities	$1m^2$	$2m^2$	$3m^2$	$4m^2$	$6m^2$	$8m^2$	$12m^2$	$18m^2$
Modules	2A	2B 4A	6A	2C 4B	2D 6B	4C	4D 6C	6D

It can be noted from figs 2,3 and 5 that 2A will provide the highest tree density and consequently [illegible] for intercropping and/or for grazing while 4D provides [illegible]

maximum opportunity for intercropping and/or grazing but will give the least tree density. Those modules such as 2B and 4A; 2C and 4B; 2D and 6B; and 4D and 6C (Fig. 3), each group with equal density but under different plant arrangement, can be expected to provide differing opportunities for intercropping as well as options for mechanization. For instance, 4A has the same tree density as 2B but its arrangement clearly makes mechanised operations both for the tree and food crops as it provides a 4m wide area for tractor operation. The same can be said for 4B, 6B and 6C versus 2C, 2D and 4D respectively. This will require 9.1 ha (if 2 Rep.) or 13.65 ha (if 3 Rep.) for 10 species for the species listed below. Block A-B for more steep slopes and/or Spinal trees, [illegible] Block D is for large trees and flat lands.

Woody species to be in the trial and demonstration are: (eg. for Ngong)

Group A. Largely trees for fuelwood and poles and timber as well as multi-purpose

1. Acacia Mearnsi
2. Cassia siamea
3. Casuarina equisetifolia
4. Eucalyptus microtheca
5. Eucalyptus candidalensis
6. Croton megalocarpa
7. Orevillea robusta

Group B. Largely shrubs or small trees for fuelwood, soil fertility and livestock feed

8. Leucaena leucocephala
9. Sesbania grandiflora
10. Prosopis Cenoraria
11. Gliricidia sepium

Food Crops to be Intercropped and grazing

Phase 1 0-3 years tree establishment period
food crops will be intercropped

Phase 2 3-12 years young plantation age - at which time food cropping will be phased out and grazing scheme visited.

Phase 3 5-15 years - [illegible]
first [illegible]
[illegible]

Phase 4 5-15 years - start of first cycle of coppicing
- Repeat cropping as Phase 1.

Food Crops to be Intercropped.

Maize
Pigeon pea
Cow pea
Beans
Cassava
Sweet potato, guards, pumkin
Castor beans

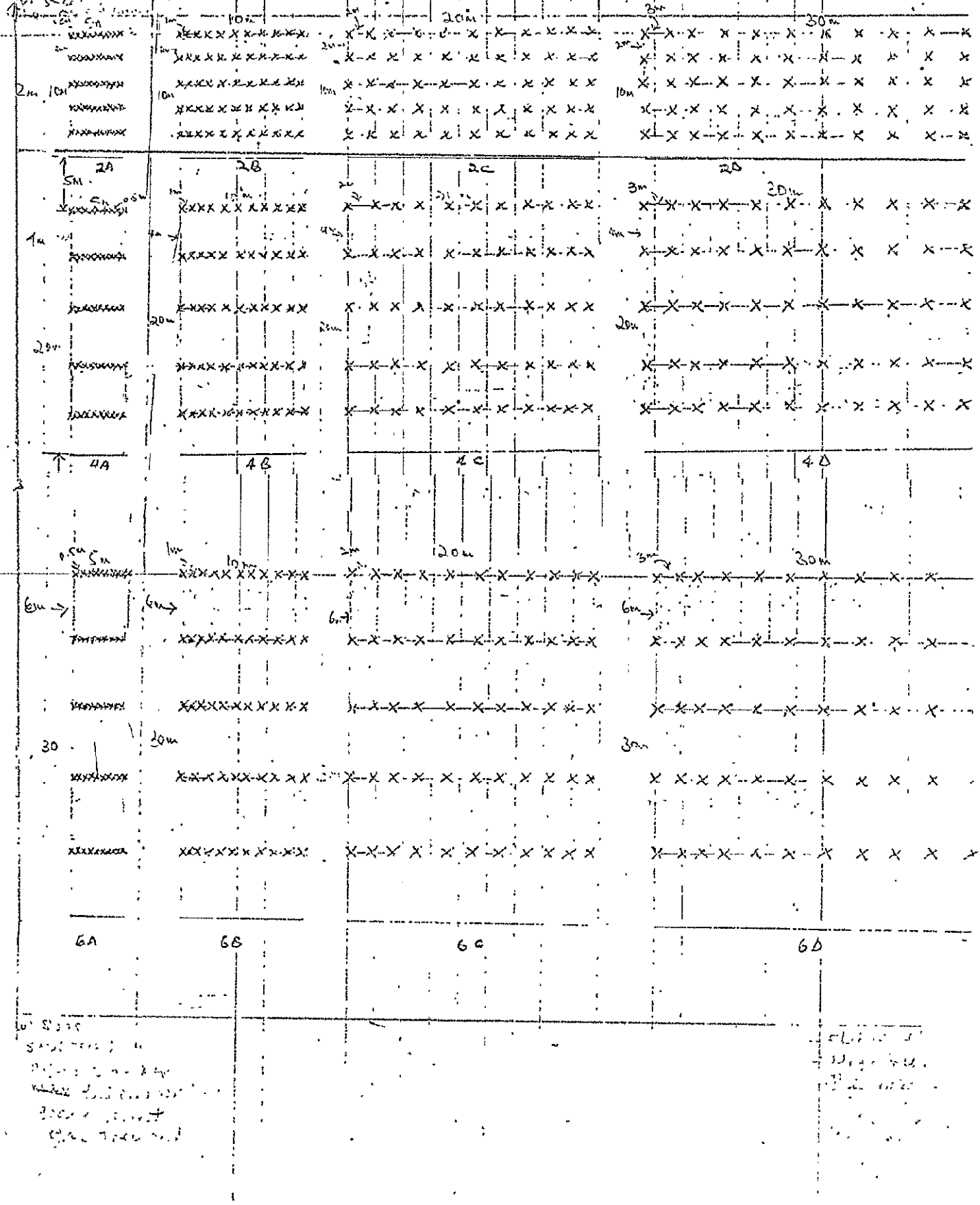
The final choice of crop or crop mixture will be determined on the basis of actual site condition and the season (short rains or/and long rains). Crop mixtures such as maize, pigeon peas, cowpea and/or beans will be planted in rows, according MOA recommendations

The over-all objective of this experiment and demonstration is:

1. To diversify products and increase total net income of the farm (food, cellulose, and energy)
2. Reduce need to weed and plough the land (reduce production costs)
3. ~~Reduce weeding~~
4. Moderate risks associated with mono-cropping
5. Keep land productive and prevent degradation.

Thus soil conditions (fertility) will be monitored as part of overall economic evaluation of the system.

Fig 5 Fuelwood/Agro-Forestry Center Experiment and Demonstration semi-detailed Planting Plan (one hap o



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[illegible] government and private nursery courses.

1.[illegible] THE NEED FOR MORE FUELWOOD/AGRO-FORESTRY DEVELOPMENT

1.3.1 Emphasis on more fuelwood development is suggested because of the current and projected situations of this ecological region, such as b village or common community woodlots or large and intensive fuelwood plantations. An attempt, must be made, however, to integrate tree/food crop/and livestock production as a natural method of landuse, whenever possible.

1.3.2 Local topography is such that soil and water erosion is a problem with intense agricultural (crop [illegible] and livestock) [illegible] woody species [illegible] for erosion control must be identified and used in the [illegible] of [illegible].

54.	Moringa oleifera	S	Ds	1,2	Hort
55.	Morus alba nigra	S	Cv	2	Hort, Con
56.	Newtonia Luchapani	T	Cv, Ds	1,2	Red, Mult
57.	Newtonia hildebrandtii	T	Cv, Ds	1,2	Red, Mult
58.	Opuntia ficus-indica	B	Cv.	2	Fed, Con
59.	Parkinsonia aculeata	S	Ds	2	Red, Fed
60.	Persea americana	T	S	1,2	Hort
61.	Piliostigma thonningii				
62.	~~Pithecolobium dulce~~		~~Cv~~		
	Prosopis pallida	T	DS	1,2	RED, CONS
63.	Populus deltoides	T	Cv.	2	Red, Con
	Prosopis alba				
64.	Prosopis cinneraria	S	DS	1,2	Fed, Red
	Prosopis chilensis	S	DS	1,2	RED, FED
65.	Prosopis juliflora	S	Ds	1,2	Fed, Red
	Prosopis farcta	S	DS	1,2	FED, RED
66.	Psidium guajava	ST	Ds, S	1,2,3	Hort, Red
	Prosopis tamarugo	S	DS	1,2	RED, CONS
67.	Ricinus communis	B	Ds	2	C
	Punica granatum	S	DS	2,3	HORT
68.	Rhyncosia sp.	B	Ds	2,3	Cons
69.	Schinus molle	T	S	1,2	Red
	Sesbania sesban(S aegyptiaca)	BS	DS	1,2,3	RED, CONS
70.	Sesbania grandiflora	B	Ds, Cv	2,3	Red, Con, Mul
71.	Tamarix gallica	T	CV	1,2	Red
	Tamarix aphylla	T	CV	2,3	RED.
72.	Tamarindus indica	T	S	1,2,3	Hort, Red
73.	Tephrosia candida	B	Ds	1,2	C, Con
74.	Terminalia catalpa	T	S, Ds	1,2	Red, Tim
75.	Thespesia populnea	T	S	1,2	Red
76.	Tipuana tipu(speciosa)	T	S, Ds	1,2,3	Red
	Salvadora persica	ST	DS	1,2,3	FED, RED
77.	Samanea saman	T	Ds, Cv	1,2,3	Red, Con, Fo
78.	Vernonia amygdalina	S	Ds	2	Hort, Con
79.	Xiceria americana(cafra)	ST	Ds	1,2	Hort, Red
80.	Zizyphus jujuba	S	Ds	1,2	Red, Hort

27. Cordia alliodora	T	S	1,2,3	Red, Tim
28. Croton megalocarpus	T	DS	1,2,3	Red, Tim
29. Dodonea viscosa	S	Ds	2	Red, Cons
30. Entrolobium cyclocarpum			2	
31. Embolica officinalis	St		1,2	
32. Erythrina sp.	T	Ds, Cu	1,2,3	CONS
33. Eriobotrium japonicum	St	Ds	3	
34. Eucalyptus camaldulensis	T	S	3	Red, TIM
35. Eucalyptus Citridodora	T	S	3	Red, TIM
Eucalyptus pomeroidula	T	S	3	RED, TIM
36. Eucalyptus sidoroxylon	T	S	3	Red, TIM
37. Eucalyptus microtheca	T	S	3	Red, TIM
38. Eucalyptus columellris	T	S	3	Red, TIM
Eucalyptus acidentalis	T	S	3	RED, TIM
39. Eucalyptus paniculata	T	S	3	Red, TIM
40. Eucalyptu tereticornis	T	S	3	Red, TIM
Eucalyptus viminalis	T	S	3	RED, TIM
41. Euphorbia Sp.	T	Cv	1,2	Red
42. Ficus Sp.	T	Cv	1,2	Con
43. Gliricidia sepiam	ST	Cv, Ds	2,3	Red, Con
44. Gmelina arborea	T	Cv, Ds	2,3	Red, Con
44. Gliricidia macalatiem	ST	Cv, Ds	2,3	Red, Con
45. Grevillea robusta	T	S	1,2,3	Red
46. Kigelia aethiopicum	T		1,2,3	
47. Lantana camara	S	Ds	2	Red
48. Leucaena leucocephala	S	Ds	2,3	
49. Leucharcarpus eriocalyx				Red, Red, Lic.
50. Mangifera indica	T	Ds	1	[illegible]
51. Melia [illegible]	St		1,2	
52. Melia [illegible]			1,2	
53. [illegible]	T	S	1,2	[illegible]