Sustainable Tree Management for Charcoal Production

Acacia Species in Kenya

Acacia Pocketbook

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Prepared for PISCES by Practical Action Consulting East Africa

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Cover images: Main: *Acacia polyacantha* woodlot at 2½ years (spacing 2.5 x 2.5 metres) in Rarieda, Nyanza (Wairimu Ngugi/PAC).

All images: Practical Action Consulting, unless otherwise stated.

Abbreviations

ACTS	African Centre for Technology Studies
DFID	Department for International Development
FAO	Food and Agriculture Organisation
g/cm3	Grams per cubic metre
KFS	Kenya Forest Service
KEFRI	Kenya Forestry Research Institute
kj/g	Kilojoules per gram
Ksh	Kenya shilling
PAC	Practical Action Consulting
PISCES	Policy Innovation Systems for Clean Energy Security
UK	United Kingdom
UN	United Nations
US$	United States Dollar

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Contents

Introduction

This publication shares information on tree growing and management for sustainable charcoal production. It focuses on Acacia species with emphasis on *Acacia polyacantha* and *Acacia xanthophloea*. Both species are native to a majority of the arid and semi-arid areas in Kenya, including parts of Bondo, western Kenya, where Practical Action is undertaking much of its work on sustainable charcoal. The publication also highlights the importance of promoting gender equity as a vital component for supporting grassroots communities to achieve sustainable charcoal production through fair sharing of resources and benefits by both men and women. The publication has been developed through a participatory process led by PAC and KEFRI through PISCES project. It seeks to support implementation of the current charcoal policy and compliance requirements and is part of a series of publications developed by PISCES to create awareness on the Forest (Charcoal) Rules, 2009.

Charcoal is a key bioenergy resource and source of energy in Kenya, providing 82 percent of urban and 34 percent of rural household energy, employment and income for over 700,000 people who support over two million dependants. Demand for charcoal is fast increasing due to population growth, increased urbanization and the development of cottage industries.

Charcoal is produced from trees grown in forests, woodlands, bush lands, grasslands, farmlands and plantations. Although the Energy and Forestry Policies and Acts have recently legalized sustainable charcoal production, numerous challenges still affect the industry, while its true value is not adequately captured in national economic statistics. Increased charcoal consumption and the use of traditional kilns have resulted in increased destruction and depletion of national tree resources. For example every tonne of charcoal produced through a traditional kiln depletes approximately 0.1 hectare of woodland. An efficient kiln would require only 0.05 hectares for every tonne of charcoal produced, a 50% saving. This calls for tree growing aimed at sustainable on-farm / community level charcoal production and widespread adoption of efficient wood conversion technologies.

Tree growing for charcoal production at the farm / community level involves both men and women in different roles and responsibilities and with different levels of access to and control over production resources including land, water, labour and financial inputs. Men and women also have different levels of access and control over benefits derived from charcoal production. This necessitates awareness creation and information sharing on the need for gender equity as a vital component of promoting sustainable charcoal production.

Species Selection for Sustainable Charcoal Production

Species choice in Kenya

Species selection, climatic conditions, tree growth rate and management practices are some of the most critical factors in sustainable charcoal production. Generally, all species of wood can be carbonized to produce charcoal. However, the quality of charcoal varies from species to species and the method of carbonisation.

Species that produce high quality charcoal include *Casuarina equisetifolia, Acacia mearnsii, Acacia polyacantha, Acacia xanthophloea, Acacia spectabilis, Eucalyptus camaldulensis, Leuceana leucocephala, Tectona grandis, Sesbania sesban* and other Acacia and Combretum species. These species are preferred mostly because they produce heavy charcoal that burns for a long time, making it economical to use.

Characteristics of tree species which are suitable for wood fuel production

- Grow quickly, yield a high volume of wood quickly, and require minimum management time.
- Coppice or sprout well from shoots.
- Have dense wood with low moisture content.
- Produce little and non-toxic smoke.
- Produce wood that splits easily and can easily be transported.
- Produce wood without thorns.*
- Yield other products or services for the household.
- Produce wood that does not spit or spark when burning.

Source: Hines and Eckman (1993)

*However there are many thorny tree species that are suitable for woodfuel production, for example *Acacia polyacantha* and *Acacia xanthophloea*, among others.

A farmer with 6 – 10 hectares of land can produce charcoal on a sustainable basis by harvesting a hectare every year for a rotation age of six years. Every year one hectare will be harvested and similarly one hectare planted with the same tree species.

Suitable woody species for wood fuel in Kenya

Acacia brevispica
Acacia bussei
Acacia drepanolobium
Acacia gerardii
Acacia hockii
Acacia lahai
Acacia mellifera
Acacia nilotica
Acacia nubica
Acacia reficiens
Acacia senegal
Acacia seyal
Acacia tortilis
Acacia xanthophloea
Afzelia quanzensis
Albizia amara
Albizia anthelmintica
Balanites aegyptiaca
Barleria spinisepala
Bauhinia taitensis
Boscia angustifolia
Combretum apiculata
Combretum brownii
Combretum constrictum
Combretum hereroensii
Combretum molle
Commiphora africana
Terminalia spinosa
Commiphora schimperi
Croton dichogamus
Dalbergia melanoxylon
Euclea divinorum
Grewia bicolor
Grewia plagiophylla
Grewia similis
Grewia vilosa
Maytenus species
Olea europaea variant africana
Prosopis juliflora
Prosopis pallida
Tarchonanthus camphoratus
Terminalia brownii

Sources: Kareko, K. K. and Githiomi, J. (2000); Barklund, E. and Palmstiema, M. (2005).

Characteristics of Acacias

Acacia is a pod-bearing group of shrubs and trees that tend to be thorny, hence they are also known as thorn-trees. Acacias are also known as wattles, including the yellow-fever acacia and umbrella acacias. There are roughly 1,300 species of Acacia worldwide, about 960 of which are native to Australia, with the remainder spread around the tropical to warm temperate regions of both hemispheres, including Africa, southern Asia, and the Americas.

One of the fastest growing thorn trees is *Acacia xanthophloea*, a large tree that is 15 to 25 metres tall with a growth rate of 1 to 1.5 metres per year. The bark is smooth, slightly flaking and yellow to greenish-yellow. It is found in semi-evergreen bushland and woodland in areas with a high groundwater table and sandy soils. The species can withstand cold and is found at altitudes ranging from 600 – 2100 metres. One cubic metre of *Acacia xanthophloea* wood produces three bags of charcoal.

Acacia polyacantha is a large deciduous tree that grows up to a height of 3.5 to 20 metres; the bark is yellow-brown and inclined to be thick or peeling in thick, corky flakes and loose strips. It grows in wooded grasslands, woodlands and bushlands, thriving in sites with high groundwater table and alluvial soils with a good mix of clay and sand. The species grows from sea level to an altitude of 1800 metres and does well with a mean annual rainfall of 300 - 1000 millimetres.

Calorific value of wood

The calorific value for wood ranges from 3.5 to 5 kilojoules per gram (kj/g) and for charcoal it ranges between 5 to 9 kj/g. Calorific value is the amount of heat produced by the complete combustion of a fuel. The value is used to determine the efficiency and effectiveness of different types of fuels. Calorific value is measured in units of energy per quantity of fuel, e.g. kg/g, while density of wood is the weight of wood per volume, e.g. grams per cubic metre (g/cm^3).

Calorific value of wood and charcoal from selected tree species

Species	Density of the wood (g/cm^3)	Calorific value of wood (kj/g)	Calorific value of charcoal (kj/g)
Acacia mearnsii	0.775	3.7	7.4
Acacia nilotica	0.624	4.9	7.3
Acacia polyacantha	0.467	4.0	6.5
Acacia xanthophloea	0.532	4.4	7.9
Casuarina equisetifolia	0.820	5.0	7.7
Commiphora africana	0.331	4.8	6.9
Commiphora baluensis	0.541	4.4	6.6
Commiphora campestris	0.388	4.2	6.9
Eucalyptus grandis	0.790	4.5	7.5
Eucalyptus maculata	0.603	–	7.4
Grevillea robusta	0.530	–	7.2
Markhamia lutea	0.356	–	8.1
Senna spectabilis	0.337	–	8.0
Terminalia brownii	0.445	4.6	7.3
Terminalia orbicularis	0.685	5.1	5.9
Prosopis juliflora	0.891	4.9	7.9
Prospopis pallida	0.834	4.9	7.8

Source: Oduor, Nellie M. (2005).

Tree Farming and Management Practices

Basic inputs for tree farming

- Land and water.
- Labour for land preparation.
- Tree nursery (establishment and management).
- Labour for tree planting, weeding and management.
- Tree protection.

Generally, trees require minimum inputs after planting compared to agricultural crops. However, weeding and protection against grazing, trampling and browsing by animals and trespass or destruction by humans is important for optimum yields. Other factors which affect successful establishment are fire, pests and diseases.

Labour inputs for plantation establishment and management (especially for Acacia species)	
Activity	Labour input in person days / hectare
Clearing and land preparation	20
Raising and transporting seedlings	4
Planting	15
Weeding and maintenance	24

Source: Jurvélius, M. (1997).

Seed collection and storage

Flowering of most Acacias is dependent on the rains. The seeding period occurs approximately six months after flowering. On average *Acacia xanthophloea* produces 24,000 to 30,000 seeds per kilogramme while *Acacia polyacantha* produces 15,000 seeds per kilogramme.

Tips on seed collection and storage

- Collect mature brownish pods from the crowns of standing trees by shaking the branches to release the pods.
- Split the pods by hands to obtain small quantities of seeds.
- Store mature and properly dried seeds in airtight containers at room temperature for up to one year.

Certified seeds

Certified tree seeds are recommended for best germination results. Seed certification is a legally sanctioned and internationally recognized system for quality control of seed multiplication and production. Certification ensures that tree growers have access to high quality seeds and propagating materials of known genetic identity and purity, with high germination rates and freedom from weed seeds. KEFRI, through its Tree Seed Programme is mandated to produce tree seeds that are collected from selected and approved tree sources. Certified tree seeds can be obtained from KEFRI Regional Centers and Sub-Centers distributed in Kenya as listed on Appendix 1. KEFRI has also contracted tree-seed stockists in Kenya as listed on Appendix 2.

Approximate price per kilogramme of certified Acacia seeds					
Acacia Species	**Local price (Ksh)**	**Export price (US$)**	**Acacia Species**	**Local price (Ksh)**	**Export price (US$)**
Acacia brevispica	1000	40	Acacia nilotica	800	40
Acacia drepanolobium	1000	40	Acacia nubica	600	40
Acacia elatior	1200	40	Acacia polyacantha	1500	40
Acacia gerrardii	1000	40	Acacia reficiens	800	50
Acacia hockii	800	40	Acacia senegal	1500	40
Acacia lahai	600	40	Acacia seyal	1500	40
Acacia mangium	1000	150	Acacia sieberiana	1000	40
Acacia mearnsii	800	40	Acacia tortilis	1500	40
Acacia melanoxylon	1000	50	Acacia xanthophloea	3000	40
Acacia melifera	1500	50	Acacia zanzibarica	800	50

Source: KEFRI (2010).

Farm preparation

- Site selection: Most Acacias are accustomed to drought in their native habitat and should be planted in areas with well-drained soil. If the soil is not well drained, the Acacia can be planted on a gentle slope or hill top. The majority of Acacias can grow in acidic, neutral or alkaline soils. For optimum growth, plant the Acacias in full sunlight.
- Land preparation: Start land preparation before the onset of the rains to remove weeds. Weeds inverted during ploughing dry up and decompose, adding nutrients to the soil. Proper soil preparation ensures the soil surface and hard pans are broken to improve water infiltration, soil aeration and easy root penetration into the soil substrate.

Seed treatment and sowing

- Acacia seeds can be sown in seedling trays or directly in the field. To achieve high germination and seedling survival rates, establish the tree nursery or sow the seeds directly during the rainy season.
- Pre-sowing treatment:
- Nick the seed coat at the cotyledon end using a knife or any other sharp tool and sow immediately;

or

- Soak the seed in hot water, cool overnight and sow the next morning.
- When sowing cover the seeds with a thin layer of sand and keep moist (water the seedling trays / beds during dry spells). Under ideal conditions germination occurs within 5 to 15 days for *Acacia xanthophloea* and 10 to 21 days for *Acacia polyacantha*. The expected germination rate for mature, healthy and properly treated seed is 40% to 90% for *Acacia xanthophloea* and 60% to 90% for *Acacia polyacantha*.

Seedling planting and management

- Start tree planting at the beginning of the long rains i.e. after approximately 100 millimetres of steady rainfall.
- Transplant seedlings after they have grown to the 2-leaf stage from seedling trays or nursery beds into nursery bags filled with a mixture of five parts river sand and one part compost (ratio of 5:1).
- Spacing is the most important aspect in the establishment of forest plantations because it correlates to the success of the forest plantation in terms of maintenance, stand stability, quality of wood and investment. For short rotation forestry for charcoal production, a minimum of 2 metres by 2 metres spacing is recommended. Clear felling is recommended for tree rows that are more closely spaced (e.g. 1 metre by 1 metre) because the remaining trees if selectively harvested would be too weak or unstable to remain upright.

Steps in seedling planting

Step 1	Make a hole measuring 45 centimetres wide by 45 centimetres deep. Separate the top soil from the subsoil when digging the hole.
Step 2	Mix the top soil with manure.
Step 3	Place the seedling inside the hole and cover with the mixture of top soil and manure.
Step 4	Gently firm the soil all around the roots.
Step 5	After planting use the subsoil to make a basin for water retention around the seedling.
Step 6	Water the seedling.

- To achieve high survival rates tree seedlings should be planted during the rainy season when watering is not necessary. However, if possible watering should be done immediately after planting. If there is no rainfall during the first week after planting, watering is necessary for achievement of a survival rate of over 70%.
- Beating up or replanting to replace any dead seedlings should be done either during the following planting season or when there is enough moisture build up in the soil.

Tree management practices

- **Weeding:** During the first two years, Acacias can be intercropped with agricultural crops such as maize, beans, groundnuts and chilli pepper. Besides reducing the cost of weeding this will ensure the trees benefit from weeding while the crops will in turn benefit from the nitrogen fixing qualities of Acacias. Regular spot weeding of 1 metre diameter around the seedling should be carried for trees that are not intercropped with agricultural crops to remove excessive vegetation until the trees form a canopy.
- **Pests and disease control:** Acacias contain organic compounds which act as natural repellents that defend / protect them against pests and grazing animals. The thorny nature of most Acacias is also a defence mechanism against browsing by animals. Some of the insect pests affecting trees in arid and semi-arid regions include termites, defoliators, sap suckers, seed and wood borer.
- **Coppicing:** Leaving a short stump of a felled tree to encourage re-growth is known as coppicing. Re-growth from a cut tree stump or the base of a damaged stem is known as a 'coppice'.

To manage a coppice, select about four dominant branches and remove the other smaller/weaker branches. These can further be reduced to two or three branches within the year.

Example of a coppicing Acacia polyacantha
(Nellie M. Oduor, KEFRI)

Labour inputs for plantation establishment and management (especially for Acacia species)	
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Clearing and land preparation	20
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Source: Jurvélius, M. (1997).

Selected pests of Acacia species and control measures			
Host	**Pest**	**Nature of attack**	**Control measures**
Acacia nilotica	*Brichiduis baudoni*	Seed borer	BHC fumigation
	Acacridium melanorhodon	Defoliator	Diazinon
	Pediosus species	Seed borer	BHC fumigation
Acacia polyacantha	*Oemida gahani*	Wood borer	Correct pruning
Acacia seyal *Acacia xanthophloea*	*Triozastus baghaasi*	Wood borer	BHC preservative
Acacia tortilis	*Sphadasmus species*	Wood borer	Diazinon
	Bruchidius longipennis	Defoliator	BHC preservative

Source: adapted from Muok et al., 2007.

Tips on pests and diseases control

- Carefully read and follow the label precautions and directions for all pesticides, fumigants, preservatives and other chemicals applied for disease and pests control.
- For further information / assistance on tree pests and diseases control contact KEFRI Regional Centres and Sub-Centres, KFS County and Zonal Offices and authorised forestry and agricultural extension agents.

Tree harvesting techniques, tools and implements

Handling both *Acacia xanthophloea* and *Acacia polyacantha* requires the use of protective gear (e.g. boots and hand gloves) due to the thorny characteristics of these species, particularly the tops of *Acacia xanthophloea* and stems of *Acacia polyacantha*. Tree harvesting should be done using methods, tools and implements that minimise damage to the surrounding site and soil.

Tools and implements for harvesting wood	
Description of tool or implement	**Purpose of tool or implement**
Wheel barrow	Transportation of wood
2-man crosscut saw (5-6')*	Wood cutting
Professional bow saw, 36"*	Wood cutting
Logging axe	Cutting of wood
Whetstone	Metal (tools) sharpening
Machete, rake	Clearing of biomass, branches
Metal file, 6-10"	Saw and other sharpening
Safety helmet	Head protection
Steel toed safety boots	Leg and feet protection
First aid kit	First aid
Pair of working gloves	Protection of hands
Ladder	Pollarding of branches of thorny trees

*For harvesting plantation grown wood.
Source: Adapted from Jurvélius, M. (1997).

General rules for sustainable harvesting of forest plantations	
1	Harvest using methods that minimise damage to the planted site and surrounding soil.
2	• Use chainsaws for big trees. For small trees use bow saws, cross-cut saws or handsaws. • Cut trees as low as possible and carefully control the felling direction (e.g. from uphill to the road into existing gaps). • Minimise the number of logging pathways and amount of movement inside the plantation. • Suspend logging during wet periods.
3	• The use of animals such as donkeys to ferry harvested trees is ideal to minimise damage to the soil on steep slopes. • The use of a small farm tractor is possible on gentle slopes. • A portable sawmill can be used to saw up cut logs at the harvesting site.
4	Stream side buffer strips of at least 20 metres on either side of the stream should be maintained.

Source: Adapted from Maua, J. and Ngazi, J. (2009).

Processing Technologies

Methods of charcoal production

The three most common methods of charcoal production are earth kilns, masonry kilns and metal kilns.

- Earth kilns are of various types but the most common are the traditional earth kiln, improved earth kiln and the Casamance kiln.
- Masonry kilns are usually of the beehive and half orange type; they are recommended for charcoal conversion in areas where fuelwood is available for prolonged periods, such as in large-scale land clearing or in fuelwood plantations.
- Metal kilns include the drum kiln, meko kiln and Mark V type.

Casamance kiln

The kiln has a chimney at the back and air-lets or channels at the side. The wood is cut into pieces measuring 0.5 metres long which are arranged upright and covered, first with grass or foliage and then soil before lighting. Carbonisation takes 2-3 days depending on the size of kiln.

Left: Wood arranged upright for Casamance kiln (Nellie M. Oduor, KEFRI)

Right: Lighting the Casamance kiln after covering the wood. The metal chimney is visible at the back of the kiln (Nellie M. Oduor, KEFRI).

The half orange kiln

The kiln is made of brick and covered for protection from rain. The wood is packed inside the kiln through a doorway, which is then sealed halfway up. The wood is lit and once it has caught fire the doorway is completely sealed. Carbonisation takes 2 to 3 days depending on the size of kiln.

Left to right: Wood arranged tightly inside the half orange kiln, and sealing the door way of the kiln (Nellie M. Oduor, KEFRI).

The meko kiln

This is a modified drum that has two chambers and two metal doors; the inner chamber is for carbonization while the outer chamber is for firing. The wood is cut into pieces measuring 0.8 metres long and packed into the modified drum kiln. After closing the doorway of the inner chamber the wood in the outer chamber is lit and the kiln's metal door is closed. The carbonization process takes 10 hours while cooling takes 3 hours.

A new meko kiln belonging to Masanga Women Group in Madiany, Bondo (PAC).

The drum kiln

The drum kiln is made from an ordinary oil drum. The kiln has a removable lid and a detachable metal ring which joins the lid to the drum. The ring has an adjustable screw which tightens the lid to the drum. The drum is modified by welding a short metal pipe that acts as a chimney onto the drum. The bottom side of the chimney has a diameter of 6 centimetres. A separate metal grill is constructed to fit inside the bottom of the kiln. The metal grill prevents fuelwood from touching the bottom of the drum, thus providing air circulation within the kiln during the process of carbonisation.

A drum kiln with feedstock (KFS).

The carbonization process takes 6 to 12 hours giving a charcoal recovery rate of 32% to 38% which is 3 to 4 times more than recovery from the traditional earth kiln. the drum kiln has a capacity of 0.4 cubic metres of wood and yields about 3/4 of a bag of charcoal. It is most suitable for domestic charcoal production using small diameter stems or tree branches.

How to use the drum kiln

Step 1 Cut the wood into pieces measuring 80 centimetres in length and split thicker logs into pieces measuring 6 to 10 centimetres in diameter.

Step 2 Place the metal grill inside the kiln and stack dried wood onto the metal grill until the kiln is fully loaded.

Step 3 Close the loaded drum with the lid which has a firing door and cover the kiln with soil, leaving the firing door uncovered.

Step 4 Stack small pieces of wood at the firing section and light the kiln. Allow the wood pieces at the lighting section to burn until the wood inside the drum catches fire and the chimney starts emitting smoke.

Step 5 Cover the firing door with soil.

Step 6 Remove the chimney when clear blue smoke is emitted thus indicating the wood is fully carbonized.

Step 7 Seal the chimney holder with grass and soil. Leave the drum to cool for 12-24 hours before removing the charcoal.

(Nellie M. Oduor, KEFRI).

Gender equity for sustainable charcoal production

The aim of promoting gender equity is to ensure fair sharing of resources and benefits by both men and women involved in charcoal production, including raising tree seedlings, and the distribution and marketing process, particularly at the small-scale community level.

The key issues to address in promoting gender equity in the charcoal sector include:

- Cultural attitudes and barriers that inhibit women's participation in decision making processes at the household and community levels. These barriers limit women's access to and control over tree production resources such as land and labour. They also inhibit women's ability to use and benefit from tree resources. For instance, due to the prevailing land tenure system in many Kenyan communities land is traditionally owned by men. Women have user rights to land but these rights are often determined by husbands or male relatives. This inhibits women's access to land and water for tree production. Similarly, women have limited access to tree tenure.
- Access to financial resources and credit for charcoal entrepreneurship determines the level of men and women's participation in the charcoal sector. Land is often used as collateral for loan facilities. Lack of land ownership therefore limits women's ability to access credit for investing in charcoal enterprise.
- Gender roles and responsibilities at the community and household levels, which determine the division of labour thus impacting on men's and women's relationship to natural resources, e.g. access to labour for tree growing, charcoal production and marketing.

Strategies for promoting gender equity in the charcoal sector include:

- Awareness raising and information sharing on the need for gender equity as a vital component of sustainable tree management for charcoal production;
- Lobby and advocacy at the community and national levels to increase women's access to and control over tree and charcoal production resources;
- Establishment of small-scale revolving funds and credit facilities for charcoal producers to support resource poor farmers, especially women.

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Appendices

Appendix 1:
List of KEFRI Regional Centres and Sub Centres

Regional Centres	Sub-Centres	Centre Director/ Officer in Charge	Telephone Contacts	E-mail & Postal Address
Muguga		Mr E. Mwanza	0722-157414 0724-259781/2 0722-157414 0722-386677	cdmuguga@kefri.org P.O. Box 20412,00200, Nairobi
	Nyeri	Dr. J. Lelon	0715-786844	
Karura		Dr. J. Githiomi	020-2011628 020-2011629 0733-764726 0722-496795	cdkarura@kefri.org P.O. Box 64636-00620,Mobil Plaza, Nairobi
Kitui		Dr. N. Kamiri	044-22311 044-22626 0722-983238	cdkitui@kefri.org P.O. Box 892, Kitui
	Kibwezi	Mr. D. Muchiri	0721-700352	
	Garissa	Mr. B. Kigwa	0722-427231	
	Bura	Mr. Kimondo	0735-333809	
Londiani		Dr. J Cheboiwo	052-64028 0722-464469	cdlondiani@kefri.org P.O. Box 382, Londiani
	Marigat	Mr. M. Welimo	0720-531655	
	Turbo	Mr. W. Atie	0722-480506	
	Lodwar	Mr. S. Ndungu	0720-143776	
Maseno		Dr. R. Nyambati	0573-51164 0713-687975	
	Kakamega	Mr. J. Maua	0721-601497	
	Ramogi	Mr. G. Wasonga	0729-779478	
	Kuja River	Mr. Ajuka	0726-561105	
Gede		Mr. T. Mbuvi	0202386358 0722-809951	cdgede@kefri.org P. 0. Box 1078-80200, Malindi

Appendix 2:
List of KEFRI Approved Tree Seed Stockists

	Company & Address	Contact Person	Telephone No.
1	Kenya Farmers Association (KFA) P.O. Box 353, Kisii	Mr. Yona Orao & Mr. Isaiah Otieno	0721231238 0725237654
2	Alpha Agrovet P.O. Box 402, Othaya	Mr. Justus Mukere	0721897380
3	Maliki Agrovet P.O. Box 612, Njoro	Mr. Harens Chazima	0712973398 or 0723236804
4	Menengai Agrovet P.O. Box 360, Nakuru	Mr. Zadock Munala	0724851302 or 0512214087
5	Science Products P.O. Box 4946, Kisumu	Mr. Moses M. Oduor	0721250752
6	Greenland Agroforestry Nursery P.O. Box 1197, Thika	Mr. Charles Nyanjui	0728480907
7	Zayuni Farmcare P.O. Box 70, Shimba Hills	Mr. Titus M. Mutonga	0721905236
8	Kinango Farm Care P.O. Box 70, Kinango	Ms. Anyango Blandina Mukhwasi	0727121398 or 0736830594
9	Kiboko Forestry and Wildlife Reserves Glitd. P.O. Box 12 Machakos	Major Charles Masai	722807907
10	Suba Green Forest Initiative, P.O. Box 111-40100, Kisumu	Mr. Julius Aduwo	0725636337
11	Snow Agrovet, P.O. Box 309, Kitui	Mr. Titus M. Katheke	0717168496 0710817504
12	Adindi Tree Seeds & Organic Gardening Supplies P.O. Box 2383, Kisumu	Ms. Beatrice Odhiambo	0735535268
13	Sifuyo Youth Empowerment Centre, P.O. Box 31, Ukwala	Mr. Stephen O. Awour	0714808397 0701008374
14	Kithimani Agrovet P.O. Box 1356, Kitui	Mr. Tommy M. Muli	0725548742 0711227770
15	Atlas Pharmaceuticals P.O. Box 1507 Ukunda	Ms Judith Mumbua Kitusa	0722480012

KEFRI's mandate is to conduct research in forestry, collaborate with other research bodies within and outside Kenya carrying out similar research, liaise with other organisations and institutions of higher learning in training on matters of forestry research, and disseminate research findings. Its mission is to enhance the social and economic welfare of Kenyans through user-oriented research for sustainable development of forests and allied natural resources. www.kefri.org

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KFS is a public institution established under the Forests Act, 2005, with a mandate to contribute to the growth of the natural resource sector by enhancing development, conservation and management of all forest resources in Kenya. Among other activities, the Service promotes community involvement in forest conservation and management through Community Forest Associations, licensing of various activities and ventures, and conservancy management. www.kenyaforestservice.org

Through action research, the PISCES project is contributing to innovation and providing new policy-relevant knowledge on bioenergy – leading to better practices and widening energy access to the rural poor in East Africa and South Asia. It is the energy Research Programme Consortium funded by the UK's DFID, whose members include ACTS (lead), Kenya; PAC-UK, Eastern Africa, and Sri Lanka; the University of Dar es Salaam, Tanzania; M.S. Swaminathan Research Foundation, India; and the University of Edinburgh, UK. For more information contact project manager Bernard O. Muok at b.muok@acts.or.ke and visit www.pisces.or.ke