



# DRYLANDS FOREST LIVELIHOODS

## FACTSHEET NO. 2: Charcoal - July 2014



### Introduction

- Charcoal is a key source of energy in Kenya, providing 82 % of urban and 34% of rural household energy. The charcoal sub-sector provides employment and income to over 700,000 people who support over two million dependants.
- Charcoal in Kenya is produced from trees growing in forests, woodlands, bushlands, grasslands, farmlands and plantations.
- Unsustainable harvesting of trees for charcoal production, increased charcoal consumption and the use of in-efficient traditional kilns are a threat to the environment through increased destruction and depletion of national tree resources.
- A traditional kiln depletes approximately 0.1 hectares of woodland for every tonne of charcoal produced whereas most efficient kilns would require only 0.05 hectares to produce the same quantity of charcoal, making a 50% saving.
- Tree growing aimed at sustainable on-farm/ community level charcoal production and widespread adoption of efficient wood conversion technologies are critical to sustain the charcoal sub-sector .

### Requirements to be a charcoal producer

- The Forests (Charcoal) Rules, 2009 require that a commercial charcoal producer should be in a registered Charcoal Producer Association (CPA).
- The Kenya Forest Service (KFS) registers and issues registration certificates to CPAs. These associations are expected to:
  - ◇ Facilitate sustainable production of charcoal by members;
  - ◇ Ensure that members implement the reforestation conservation plans;
  - ◇ Assist KFS in enforcing the provisions of the Forest Act relating to sustainable charcoal production, transportation and marketing;
  - ◇ Do any other thing that is necessary for sustainable charcoal production and transportation.

### How to obtain a license to undertake commercial charcoal production and transportation

- Make an application to The Director, KFS through the respective Forest Conservation Committees (FCC) presenting the following information;
  - ◇ The Association's registration documents,
  - ◇ The source of charcoal,
  - ◇ The designated charcoal collection points,
  - ◇ Consent from the owner, or authorized person of the land where charcoal is to be produced,
  - ◇ Tree species, number of trees and estimated volume to be used for charcoal production; type of technology to be used,
  - ◇ Recommendation from the local environment committee,
  - ◇ The reforestation or conservation plan for the area where trees will be managed for charcoal production.
  - ◇ Any other information that the FCC may require.
- Pay the prescribed fee;
- The licensing subcommittee of the FCC evaluates the applications and makes recommendations to the Director KFS.
- Based on these recommendations the Director makes a decision whether to license or not.

### Streamlining trade in charcoal

- It is also recommended that CPAs brand their charcoal giving the tree species and the weight of the package charcoal
- It is proposed that collection points should be established in various ecosystem areas
- To move charcoal from one place to another one requires: a valid charcoal movement permit from Kenya Forest Service, a certificate of origin for the charcoal and a receipt from the vendor
- A person wishing to export or import charcoal and charcoal products from Kenya is expected to make an application to the KFS Director through the respective Licensing Sub-Committee
- A person engaged in wholesale or retail trade in charcoal is expected under the rules to keep a record of the sources of charcoal, and copies of the certificate.

## Tree species for charcoal production

There are many tree species suitable for charcoal production that could be established as plantations in the drylands. These species are preferred mostly because they produce heavy charcoal that burns for a long time, making it economical to use. The species include :-

- *Acacia horida*
- *Acacia mearnsii*
- *Acacia mellifera*
- *Acacia nilotica*
- *Acacia polyacantha*
- *Acacia senegal*
- *Acacia seyal*
- *Acacia tortilis*
- *Acacia xanthophloea*
- *Balanites aegyptiaca*
- *Casuarina equisetifolia*
- *Combretum molle*
- *Combretum schumannii*
- *Croton macrostachyus*
- *Eucalyptus species*
- *Markhamia lutea*
- *Olea africana var europea*
- *Prosopis juliflora*
- *Senna siamea*
- *Tarchonanthus camphoratus*
- *Terminalia brownii*
- *Terminalia prunioides*
- *Terminalia spinosa*

## Sustainable charcoal production Harvesting

Various tools and implements are required for harvesting wood for charcoal production (Table 1). Due to the thorny characteristics of some of the species, handling of the trees requires the use of protective gear (boots and hand gloves).

Table 1: Tools and implements used in harvesting wood or charcoal production

Description of Tool or Implement	Purpose of Tool or Implement
First aid kit	First aid
Steel toed safety boots	Leg and feet protection
Safety helmet	Head protection
Pair of working gloves	Protection of hands
Whetstone	Sharpening of cutting instruction
Metal file, 6-10"	Saw and other sharpening
Machete, rake	Clearing of biomass, branches
Saws: chainsaw/ 2-man crosscut saw (5-6')*/ hand saw/bow	Tree felling and cross cutting
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Logging axe	Splitting of logs
Wheel barrow	Transport of wood



## **General rules for sustainable harvesting of forest plantations**

When harvesting the trees, it is important to use methods that cause minimal damage to the site and maximize yield by observing the following:

- Minimize the period between harvesting and replanting so as to ensure the soil is not over-exposed.
- Use chainsaws for big trees and bow saws, cross-cut saws or handsaws for small trees. A portable sawmill is recommended to cross cut logs on site.
- Cut trees as low as possible with careful control of felling direction (from uphill to the road into existing gaps).
- While moving the logs minimise the number of trips and suspend logging during wet periods to avoid soil compaction.
- Use animals for example donkeys to transport harvested material as opposed to tractors to minimise damage to the soil on steep slopes. The use of a small farm tractor is possible where the slope is gentle.

## **Methods of charcoal production**

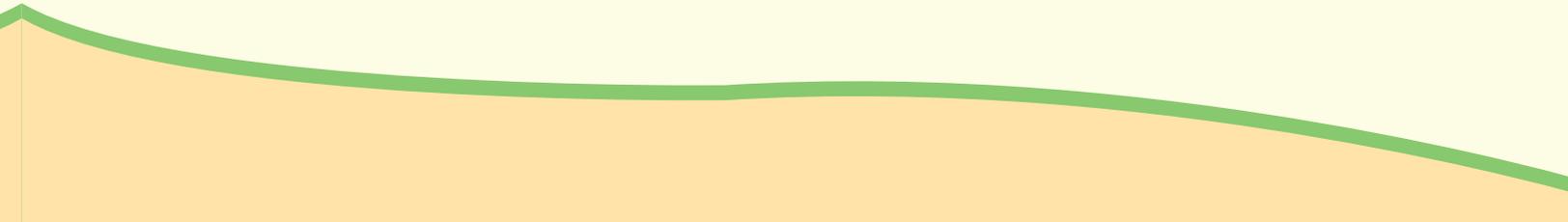
- The major factors that influence charcoal conversion efficiency and yield are:-
- Moisture content of the wood at time of carbonisation (optimum 20% or less).
- Type of carbonising equipment (kiln) used.
- Management of carbonisation process (mainly stacking of wood and air control).

High charcoal conversion efficiency and quality can be achieved through proper control of the carbonisation process.

## **The three most common methods of charcoal production today are Earth Kilns, Masonry Kilns and Metal Kilns.**

- **Earth Kilns** are of various types but the most common are the traditional, improved earth kilns and the Casamance kiln.
- **Metal Kilns** are of the Drum kiln, Meko kiln and Portable Metal Kiln.
- **Masonry Kilns** are usually of the Beehive and Half Orange type; they are recommended for charcoal conversion in areas where there is available fuelwood over a long time period, such as large-scale land clearing and fuelwood plantations.

Some of the easily adoptable kilns include; Casamance, Drum and Half Orange type kilns. A step by step description of their use is presented.



## Casamance Kiln

- The Casamance kiln is a modified earth kiln that has one chimney and four airlets.
- The chimney made of gauge 26 galvanised iron sheets, is 180 cm long with a diameter of 15 cm .
- The airlets made of the same material as the chimney are 60 cm long with a diameter of 5 cm.



### Step 1

- Arrange twigs on the ground in a circular way leaving spaces between them for air to flow easily
- Cut wood into 0.5 m length pieces and arrange them upright on Top of the twigs starting from the centre. The larger diameter wood pieces are placed at the centre surrounded by the smaller diameter wood pieces



### Step 2

- Ensure stacking is done as tightly as possible.
- Fill any gaps between the wood with small wood pieces to allow for better heat transfer
- Place the chimney on one end of the arranged wood in the direction of the wind



### Step 3

- Cover the wood with leaves or grass



### Step 4

- Place the airlets on the sides of the kiln
- Put soil on top of the leaves securing a lighting point
- Light the kiln
- Once the wood at the lighting point has caught fire, the lighting point is sealed off with leafy twigs, grass and soil



### Step 5

- Dense white smoke indicates the process of carbonisation is progressing well.
- A light bluish coloured smoke indicates the wood is carbonised and charcoal is ready

Conversion of wood to charcoal takes 3-4 days (depending on kiln size) to yield a recovery rate of about 30%

## The Drum Kiln

- This is simple metal kiln made from a modified ordinary oil drum.
- The Drum-kiln has a fabricated removable lid with a firing door and a metallic belt that joins the lid to the drum. It also has a removable metal grill and a chimney at the end opposite the door.
- This kiln is suitable for household domestic charcoal production using small stems or tree branches of not more than 10 cm diameter.



### Step 1

- Ensure the wood is dry before use by drying for 2- 4 weeks
- Cut the wood into pieces measuring 80 cm length
- Place the metal grill inside the kiln and arrange the wood pieces on it



### Step 2

- Pack the kiln until fully loaded ensuring close packing of the wood



### Step 3

- Close the loaded drum with the lid which has a firing door



### Step 4

- Stack small pieces of wood at the firing section for lighting the kiln



### Step 5

- Light the kiln and allow the wood pieces at the lighting section to burn until the wood inside the drum catches fire and the chimney starts emitting smoke
- Cover the kiln with soil, leaving the firing door uncovered. The soil is for insulation to prevent heat loss during carbonisation



### Step 6

- Close the firing door after ensuring the wood in the kiln has caught fire



### Step 7

- Cover the firing door with soil and allow the wood to carbonize until the chimney emits clear blue smoke, indicating the wood is fully carbonized
- Conversion of wood to charcoal takes 6 - 2 hours giving a chacoal recovery of 32 - 38 %



### Step 8

- Remove the chimney and seal the chimney hole with grass and soil
- Leave the drum to cool for 12-24 hours
- Remove the soil to uncover the drum kiln
- Remove the charcoal

## Half Orange Kiln

- Brick kilns are of various shapes, dimensions and designs. The capacities vary depending on dimensions from small-sized kilns producing 4-5 bags to those that can produce 80-120 bags.
- The kiln walls are 30–40 cm thick for small sized kilns and 42–48 cm thick for larger kilns to insulate the wood being carbonised from excessive heat loss. This wall also conducts heat to enable cooling after the carbonization process.
- Air inlets are constructed at the base while holes which control flow are placed mid-way to the top.
- The large capacity kilns can utilize huge chunks of wood including stumps to make charcoal
- These kilns are fixed to the ground at a central point where the wood is brought to the kiln or where volume of timber is available over a long period. It is recommended to build an iron-sheet roof over the kiln.
- The kilns require more time to complete charcoal carbonisation due to slow cooling process.
- Maintenance and operating labour costs are high as doors and other openings have to be constructed with each firing while the brick walls require frequent repairs to seal cracks



### Step 1

- Place small lengths of wood with diameters of not more than 8-10cm on the bottom of the kiln
- Stack the wood upright starting at the back wall of the kiln, progressing towards the door placing the larger diameter logs at the centre of the kiln. The top layer of wood is placed horizontally on the upright wood



### Step 2

- Ensure that the air inlets/holes are not blocked
- Once the kiln is fully loaded, smear a slurry of mud and ash to make the bricks less porous to air



### Step 3

- Close the door opening with bricks. This is done until half way up to leave space for lighting the wood



#### Step 4

- Smear the bricks of the door-way with a mixture of mud and ash to make them air-tight



#### Step 5

- Light the wood



#### Step 6

- Once the wood has caught fire then close up the door opening with bricks followed by a mixture of mud and ash



#### Step 7

- Allow the wood to carbonize until bluish smoke is emitted from the chimney.
- Then block the airlets (holes) with bricks.
- Allow the kiln to cool. Accelerate cooling by throwing a mud slurry on the kiln. Apart from cooling, this helps to cover any hole or crack in the walls, thereby preventing any entry of air
- The slurry of mud and water must be applied about three times per day



#### Step 8

- Before removing the charcoal, when the kiln is sufficiently cool, a pile of soil must be available for use in case the wood re-ignites when the door of the kiln is opened
- Break open the kiln door
- Remove the charcoal from the kiln with a special fork/rake
- Spread out the charcoal on the ground and cover with soil to cool further and to prevent charcoal re-ignition
- Charcoal recovery ranges from 25 - 30%