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ENERGY IN WOODY BIOMASS

TREE BIOMASS: HOME-GROWN AND LOCALLY OWNED ENERGY

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UTILIZING MATHENGE (*PROSOPIS JULIFLORA*) FOR CHARCOAL

THE OTHER SIDE OF AN INVASIVE SPECIES

Improved Earth mound Kiln (IEK) outfitted with 6 breathers and 2 chimneys. Photo Mary Njenga/ICRAF

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INTRODUCTION

About a third of the world's population relies on solid biomass for cooking and heating using traditional stoves. Of those users, 50% are in developing countries especially Sub-Saharan Africa where 90% of households rely on woodfuel (charcoal and firewood) for cooking and heating (IEA, 2017). By 2013, Kenya used 2.5 million tonnes of charcoal and earned 1.6 billion USD annually, despite the deficit in supply of 55% (MEWNR, 2013). This growing demand for charcoal following urbanization and population increase and the need to find sustainable solutions for supply, are good reasons to utilize the invasive mathenge tree (Prosopis juliflora) which covers 2% of the land in Kenya with a biomass of 37t/ha utilizable for charcoal production (Choge, 2011).

Prosopis juliflora has spread and colonized the tropics of Latin America to Asia and Africa. In Kenya, *Prosopis juliflora* was introduced in the 1970's- 1980's to arrest desertification and address woodfuel shortages, but the species aggressively adapted itself and now covers another 500-1300ha/ year in drylands such as Turkana, Baringo, Garissa, Tana River and Taita Taveta Counties blocking roads, waterways, and displacing settlements, crop lands, woodlands, and pasture lands (Ng *et al.,* 2017). This brought dissatisfaction to the local communities in the affected areas as the tree was associated with dangerous thorns that caused injuries to humans and their livestock. Efforts to manage the tree did not bear much fruit because the tree is thorny, impenetrable and requires sophisticated tools to cut. The local communities campaigned to the government to remove the species; little did they know the species could be a valuable resource.

AN INITIATIVE ON PROSOPIS CHARCOAL

Recently the government of Kenya has allowed communities to make charcoal using Prosopis. This presented a win-win case for the community as they now have an incentive to promote the management of the species. The World Agroforestry (ICRAF) in partnership with the Adventist Development and Relief Agency International (ADRA), the Food and Agriculture Organization of the United Nations (FAO) and Baringo County are implementing a project aimed at generating knowledge,

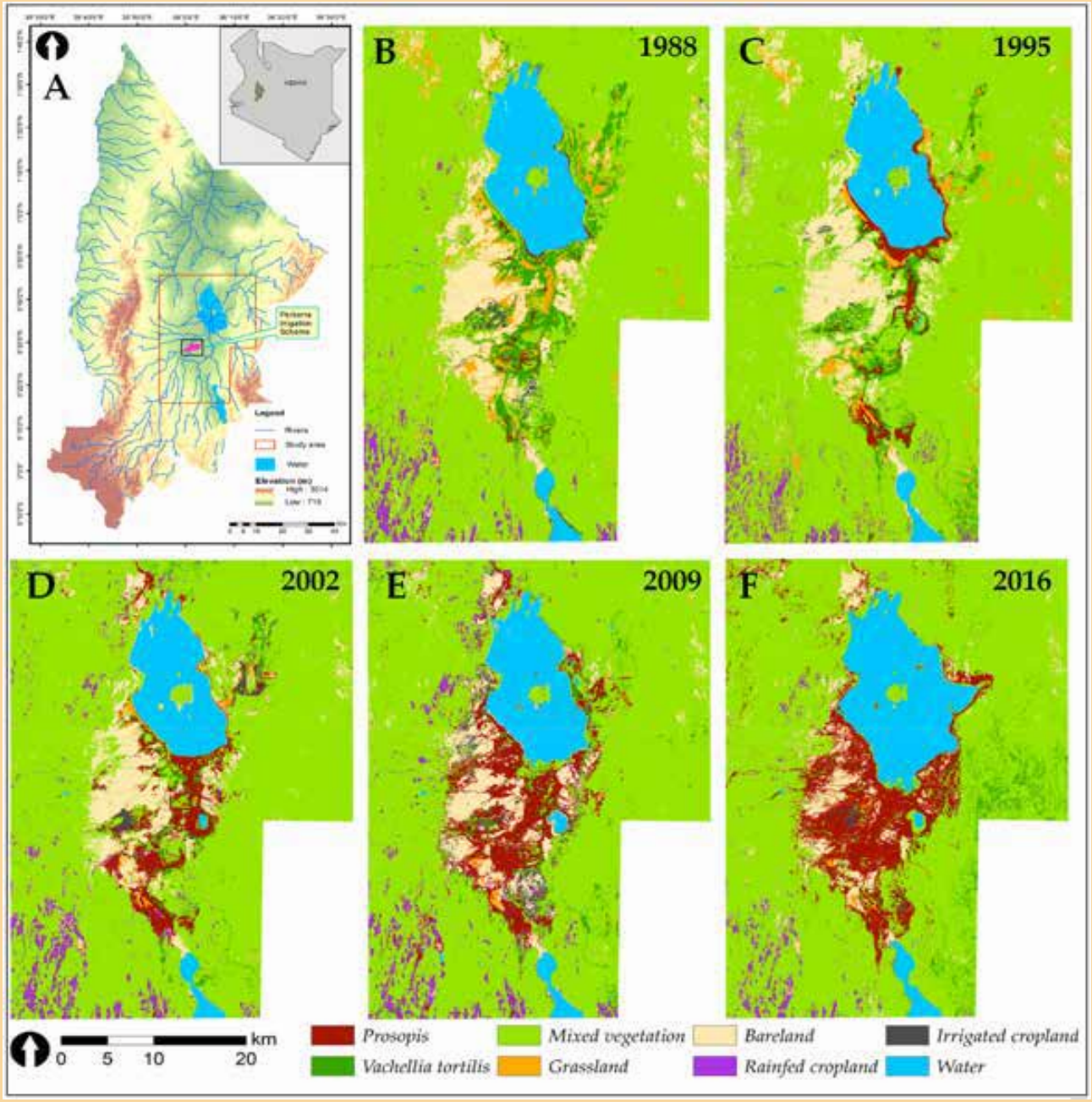

Figure 1. The evolution of an invasion
(A) Overview map of Marigat subregion, Baringo County, Kenya;
(B-F) Land Use maps from 1988 to 2016. The red-brown colour shows the areas where *Prosopis juliflora* dominates the vegetation. Prosopis advanced on average by 640ha/year.(Mbaabu et al., 2019).

- Mbaabu PR, Ng WT, Schaffner U, Gichaba M, Olago D, Choge S and Eckert S 2019 Spatial evolution of Prosopis invasion and its effects on LULC and livelihoods in Baringo, Kenya Remote Sens. 11(10) 1217. https://www.mdpi.com/2072-4292/11/10/1217
- Reference for pg. 37
  Ng WT, Rima P, Einzmann K, Immitzer M, Atzberger C and Eckert S 2017 Assessing the potential of sentinel and Pléiades data for the detection of Prosopis and Vachellia Spp. in Kenya. Remote Sens 9 74 https://www.mdpi.com/2072-4292/9/1/74

Stacking wood tightly to reduce air spaces and enhance heath transfer. Photo Mary Njenga/ICRAF

policy options and facilitating engagement for more sustainable woodfuel value chains in Kenya. Extra support was provided by the CGIAR programme on Water, Land & Ecosystems (WLE)-sustaining rural-urban linkages.

Analysis from the project has showed that the species has potential to provide communities with 14 different products and services with charcoal ranking highest and food for humans the lowest (Njenga et al. 2019: Table 1).

Table 1. *Commodities and services provided by mathenge (Prosopis juliflora)*

Benefits of Prosopis as ranked by women and men	***Women Rank***	***Men Rank***
Charcoal	1	1
Firewood	2	4
Fencing	3	2
Shade	4	6
Posts	5	3
Roofing	6	8
Soil erosion control	7	5
Furniture making	8	10
Improvement of soil fertility	9	9
Medicinal value (roots)	10	13
Animal feeds	11	11
Windbreak	12	7
Wound soothing	13	14
Food for human beings	14	12

In terms of contribution to livelihoods, both men and women rank charcoal among the top three livelihood sources after farming and livestock keeping (Table 1). Pods, another product from Prosopis can be sold as feed for livestock at KES 100 (USD1) per 50kg bag.

Table 2: *Annual livelihood calendar for communities in Marigat in Baringo county*

Activity	***Months***											
Rank of product	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
(1) Charcoal production	xx	xx	x	xxx	xx	x	x	xxx	xx	x	xx	xxx
(2) Bee keeping	x	x	xx	xxx	xx	x	xx	xxx	x	xx	xx	xxx
(3) Livestock keeping	xx	x	x	xxx	xx	x	x	xxx	xx	x	x	xxx
(4) Farming	x	x	xxx	xxx	xxx	xxx	xxx	xxx	xx	xx	xx	x

xxx- high, xx-medium, x-low

High charcoal production in April, August and December is attributed to availability of labour as schools are closed and the youth are at home. This is fueled by high demand for money for school fees and favorable weather conditions; active Prosopis management can be achieved during those months.

Sustainable charcoal production includes consideration of the entire charcoal value chain. From the production to the end of the value chain, it includes wood sourcing, drying wood well to reduce moisture content, proper stacking of wood to reduce air spaces and enhance heat transfer and monitoring kilns to enhance charcoal yield.

During trainings of the community, Improved Earth Mound Kilns (IEK) were demonstrated. Other improvements of Traditional Earth Mound Kiln (TEK) included fixing 6 breathers and 2 chimneys at a cost of KSH5500 (USD50.5) which each producer was supported with by the project. After the training, charcoal yield from the IEK was 50% higher than from the TEK.

Demonstration on thinning & pruning of Prosopis at KEFRI Baringo. Photo Mary Njenga/ICRAF

Similar results were obtained in Democratic Republic of Congo where charcoal yield from IEK between trained and non-trained charcoal producers tripled for the former group (Schure *et al.*, 2019)[1].

Lorem Ipsum

If thinned and pruned stems are below 5cm in diameter they are better carbonized using a drum kiln, a kiln type which was introduced during the training. The resultant charcoal is then used as fuel or added into the soil as biochar or processed into charcoal briquettes.

CHALLENGES THAT STILL NEED TO BE ADDRESSED

Despite the high promising potential of Prosopis for charcoal as a management tool, the

Note from the Editor: Many kiln types have been proposed and tried, both of the mobile and fixed kind. Despite those efforts, the traditional earth mound, although less efficient, is still the most widely used, by far. This is because it is convenient (no extra materials except soil, grass and the biomass), cheap and, well, traditional, meaning the skills are wide-spread. And it can be constructed fast and anywhere.

The Improved Earth mound Kiln (see text box next page), stands a fair chance of adoption, because it greatly resembles the traditional type, and because the extra inputs are few, simple, cheap, sturdy, and easy to find.

communities still face a wide range of challenges such as,

1) perception of Prosopis charcoal as of low quality compared to indigenous species such as Acacia,

2) fluctuation of charcoal prices,

3) long and complex permit system for charcoal production and trade, and

4) it is hard to cut the tree with machetes (pangas) and axes, limiting the area charcoal producers can be able to harvest the wood.

The challenges could be addressed through collaborative actions of the government, research and development organizations, community-based organizations, and local communities by:

1) strengthening CPAs so that they can manage leasing and sharing of equipment for harvesting and processing Prosopis,

2) promoting formation of Village Saving and Loan Association (VSLAs) and links to other rural finance options to enable producers to buy the equipment for harvesting and processing the tree,

3) promoting charcoal production using IEK to increase yield and earn more income to support other livelihood activities and enhance environmental health.

TAKE HOME MESSAGE

Management and utilization of the almost 19,000 hectares of *Prosopis juliflora* in Baringo for sustainable charcoal production presents potential for improving livelihoods and the environment. It presents an opportunity for supplying the growing urban centers with affordable cooking fuel, a strategy that can be scaled out to the other affected counties.

Also, there is need for complete removal of mathenge in some pockets to create room for enrichment with native high-value multipurpose tree species to enhance biodiversity.

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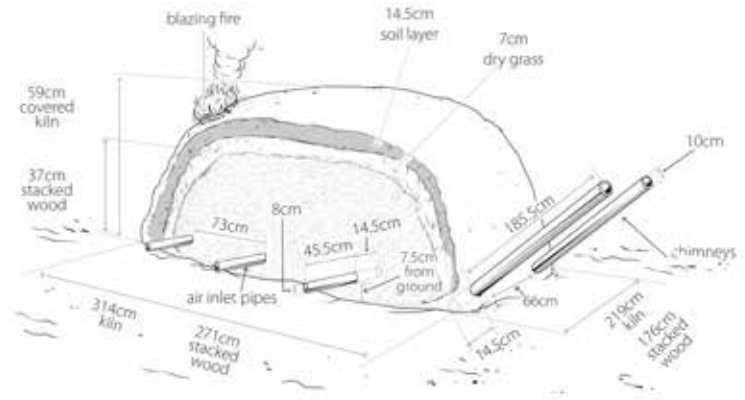

Drawing by Fucha Media

NOTES ABOUT THE IMPROVED EARTH MOUND KILN (IEK)

The improvement consists of the use of chimneys and inlets, in the form of Galvanized Iron (GI) pipes. The kiln shown on the design is small, 2x3m and 60cm high. This covers about 750kg of dry wood. Bigger kilns are possible. For this size, there are 2 chimneys and 6 air inlets. The kiln is covered by a layer of grass (7cm thick) and soil (15cm thick), total cover thickness 22cm.

Chimneys

Diameter 10cm, total length 2m of which 185cm sticking out of the kiln, and 15cm inside, penetrating the soil layer and sitting on the grass layer, and should not touch the wood to avoid burning.

Air inlets

Two times 3 GI pipes of diameter 8cm and length 60cm of which 45cm sticking out of the kiln and 15cm inside penetrating trough the soil layer and touching the grass layer. The inlets should not touch the wood to avoid burning.

Firing of the kiln is done at the opposite (windward side, that's the direction the wind is coming from) of the chimney side, on the upper part.

Developed by KEFRI (Nelly Oduor *et al.*, 2006)