Addressing Urban Woodfuel Demand Induced Forest Degradation Through Nature Based Solutions

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Table of Contents

- Charcoal production in Africa
- Charcoal degradation waves around urban centres
- Charcoal degradation waves around Dar es Salaam
- Charcoal supply routes in Kenya
- Charcoal production in Mutumo
- Sustainable biomass harvesting regime for Mutomo

Charcoal in Africa

- Charcoal is the fuel of choice in many African urban areas
- It is one of the drivers of deforestation and forest degradation

. Top ten countries for average annual net loss of forest area, 2010-2020

Ranking	Country	Annual net change		
		1 000 ha/yr	%	
1	Brazil	-1 496	-0.30	
2	Democratic Republic of the Congo	-1 101	-0.83	
3	Indonesia	-753	-0.78	
4	Angola	-555	-0.80	
5	United Republic of Tanzania	-421	-0.88	
6	Paraguay	-347	-1.93	
7	Myanmar	-290	-0.96	
8	Cambodia	-252	-2.68	
9	Bolivia (Plurinational State of)	-225	-0.43	
10	Mozambique	-223	-0.59	
Note: The ra	te of change (%) is calculated as the compound annual change rate.			



Charcoal degradation waves around the urban centres





Areas of sequential forest degradation intensity around the city of Tete, Mozambique in 2015 modeled based on information collected at road selling points and charcoal kilns. The map shows that waves, 1 and 2 taking place at 90 km and Wave 3 at 60 km from the city of Tete.

Von Thunen - A Model of Agricultural Land Use

Source: Silva et al. 2019

Charcoal degradation waves around Dar es Salaam



Map of the degradation waves of dominant forest use in the study area in 1991 and 2005.



Patterns in forest use and condition at increasing distance from DES.

Source: Ahrends et al., 2010

Charcoal supply routes in Kenya

- Charcoal supply routes in Kenya lead to major urban centres
- Main consumption centres are Nairobi, Mombasa and Kisumu
- Price increases with size of demand



Charcoal production in Mutomo, Kitui County

- Kitui County one of the main charcoal production areas
- Mutomo has dry woodlands/ savannah dominated by Acacia-Commiphora tree species
- Hardwoods targeted for charcoal production
- Woodlands heavily deforested/ degraded-species composition, species richness and basal area



Source: Ndegwa et al., 2018

A proposed sustainable biomass harvesting regime for Mutomo

- Mean Annual Increment (MAI) of the woodlands between 4-4.8%
- Woodlands able to recover and provide charcoal

Number of years it would take the woodlands to recover at

• Time to woodland recovery depends on % of MAI harvested- **balance is key!!!**





Time to recovery @ MAI= 4.8%

TABLE 2A	Estimated	sustainable	charcoal	production	from	available	biomass a	at 4.0% M	1AI
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Year	HW trees biomass per ha (t)	Total HW trees biomass (t) ^a	Increment HW trees biomass (t)	Total charcoal yield from 80% increment biomass (t)	Total charcoal yield from 80% increment biomass (35 kg bags)
0	3.80	588,335.0	0.0	0.00	0
5	3.96	613,107.0	24,524.3	4,904.9	140,139
10	4.16	644,072.0	25,762.9	5,152.6	147,216
15	4.41	682,778.3	27,311.1	5,462.2	156,064
20	4.71	729,225.8	29,169.0	5,833.8	166,680
25	5.07	784,962.8	31,398.5	6,279.7	179,420
30	5.50	851,537.5	34,061.5	6,812.3	194,637
35	6.04	935,143.0	37,405.7	7,481.1	213,747
40	6.69	1,035,779.3	41,431.2	8,286.2	236,750
45	7.48	1,158,091.0	46,323.6	9,264.7	264,707
50	8.44	1,306,723.0	52,268.9	10,453.8	298,680
55	9.61	1,487,868.3	59,514.73	11,903.0	340,084
60	11.04	1,709,268.0	68,370.72	13,674.1	390,690
64.3	12.50	1,9353,12.5	77,412.5	15,482.5	442,357

Note. HW = hardwood.

^aBiomass per hectare multiplied by the total woodlands area (154,825 ha).

TABLE 2B Estimated sustainable charcoal production from available biomass at 4.8% MAI

Year	HW trees biomass per ha (t)	Total HW trees biomass (t) ^a	Increment HW trees biomass (t)	Total charcoal yield from increment 80% biomass (t)	Total charcoal yield from 80% increment biomass (35 kg bags)
0	3.80	588,335.0	0	0	0
5	4.00	619,300.0	29,726.4	5,945.3	169,865
10	4.25	658,006.3	31,584.3	6,316.9	180,482
15	4.58	709,098.5	34,036.7	6,807.4	194,496
20	4.98	771,028.5	37,009.4	7,401.9	211,482
25	5.49	849,989.3	40,799.5	8,159.9	233,140
30	6.14	950,625.5	45,630.0	9,126.0	260,743
35	6.96	1,077,582.0	51,723.9	10,344.8	295,565
40	8.00	1,238,600.0	59,452.8	11,890.6	339,730
45	9.31	1,441,421.0	69,188.2	13,837.6	395,361
50	10.96	1,696,882.0	81,450.3	16,290.1	465,430
53.8	12.50	1,935,312.5	92,895.0	18,579.0	530,829

Note. HW = hardwood

^aBiomass per hectare multiplied by the total woodlands area (154,825 ha).

Thank You!!! Asanteni!!