

Assessing the Uptake of Modern Kiln Technology in Mutomo, Kitui County, Kenya

John Kioli¹, Evelyn Wemali² & Ngare Innocent³

¹Kenyatta University, P.O. Box 43844-00100, Nairobi, Kenya,

²Kenyatta University, P.O. Box 43844-00100, Nairobi, Kenya,

³Stockholm Environment Institute, P.O. Box 30677-00100, Nairobi, Kenya.

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ABSTRACT

The demand for energy on developing nations has increased in the past three decades propelled by population growth. This has led to more biomass energy consumption and use in the households. For this study, we assess factors that will propagate better uptake of modern kilns that are environmental friendly and minimal on waste of wood fuel for the production of charcoal in Mutomo. Methodology of the study employed the following sampling techniques: random sampling; stratified sampling and purposive sampling during the survey. The sample size was 255. The methods of data collection used were observation and questionnaires. Both qualitative and quantitative data was obtained. Qualitative data was analysed through content and thematic analysis where the information received from the respondents were captured as were stated. The discussed findings also indicate the perceptions towards the uptake of modern charcoal producing kilns. Further, we analyze challenges of transitioning from traditional earth kilns to modern technology kilns. We conclude that, equitable use of environmental resources depend on better technologies that facilitate sustainability. Therefore the efficiency and economical characteristics of modern kilns play an important role in their adoption because they help in getting high quality charcoal such that the traders are able to get maximum returns. For the socioeconomic wellbeing of charcoal producers, modern kilns are economical and profit generating thus maintaining the forest cover unlike tradition kilns that degrades it. The formation of charcoal processing associations is the main way of encouraging the use of modern charcoal burning kilns other than the sensitization of the public on the benefits of the use of modern charcoal burning kilns.

1. Introduction

The overreliance of biomass for the supply of wood energy and its deliverables by developing nations globally pose threat to the natural forest cover (Bailis *et al.*, 2017). Though, it is obtained from the renewable resource, the world's forests are shrinking faster than they are being replaced. A study conducted by The United Nations Food and Agricultural Organization FAO (2010) indicate that nearly 11.3 million hectares of forests are lost annually to agriculture, commercial timbering and uncontrolled fuel wood production and consumption. Ndegwa *et al.* (2016) ascertains that,

the traditional Charcoal Earth kilns methods persist to this day in many developing countries, mainly because they are cheap. However, they often produce very low yields (typically 1 kg of charcoal from 8 to 12 kg or more of wood), inconsistent quality because it is difficult to maintain uniform carbonization and environmental pollution from the release of tars and poisonous gases.

A report by Kenya's Ministry of Environment Water and Natural Resources (2013), indicate that, in Kenya close to 22 million cubic meters of wood is carbonized to meet Kenya's annual charcoal demand. The charcoal production sub-sector

creates jobs for wood producers, charcoal producers, and transporters and reportedly employs almost 1 million people on a part and full-time basis across the value chain (Ministry of Environment Water and Natural resources ,2013). In Kenya, wood-to-charcoal conversion efficiency rates range between 10-15 % with only a few cases achieving rates above 20% (Njenga *et al.*, 2017). Second generation kilns _ include the modified earth mound, Brazilian bee-hive, half-orange brick, drum and the casamance kilns have higher efficiency rates of up to 30% (Lohri, 2015).

2. Statement Problem

Although the modern kilns are more efficient and produce better quality charcoal, it is observed that a limited number of charcoal producers have embraced the technology. A recent research by Green Africa Foundation (2013) indicated that charcoal producers in Mutomo sub-county are still using traditional charcoal production methods that have been found to be unsustainable. This paper seeks to assess factors that would propagate a transition to modern charcoal kilns by the charcoal producers.

3. Methodology

The study was an exploratory survey within the area of study Mutomo sub-county Kitui county Kenya. Both primary and second data were used for the development of the document. Methodology of the study employed the following sampling techniques: random sampling; stratified sampling and purposive sampling during the survey. The sample size was 255. The methods of data collection used were observation and questionnaires. Both qualitative and quantitative data was obtained. Qualitative data was analysed through content and thematic analysis where the information received from the respondents were captured as were stated. Primary data was obtained from field collected data while literature was through desktop reviews, reports and journals. The methods of data collection used were observation and questionnaires.

4. Results

4.1 Factors Influencing adoption of Modern Charcoal Kiln

Table 1 indicates the responses of respondents when asked about the factors that influenced their perceptions on charcoal production. Perception towards charcoal production in Mutomo Sub-County was determined by the following factors: size of land. Location of kiln, efficiency of kiln and quality of charcoal. Majority of respondents 76.9 % (n = 196) affirmed that the efficiency of the kiln

determined how charcoal was produced in the area. This was followed by the quality of charcoal that had 8.6 % (n = 22) response from the participants during the survey. The respondents perceived that the size of land had a stake on charcoal production with 6.7% response rate. This was slightly higher to location of the kiln from the participant perception recording 5.0%. From the data, it shows that, the participants perceived the efficiency of the kiln to contribute to better charcoal production. However, majority of the kilns were earth kilns in the area of study. Location of the kiln had the least response from the participants. This indicates that, a location of the kiln does not determine quality of charcoal production but its efficiency like the modern kilns.

Table 1: Factors Influencing Perception on Charcoal Production

Factor	Frequency (N = 255)	Percentage (%)
Size of land	17	6.7
Location of kiln	2	5.0
Efficiency of kiln	196	76.9
Quality of charcoal	22	8.6
Total	255	100

4.2 Opportunities in Adoption of Modern Charcoal Kilns

Table 2 shows sought opinions of the respondents on the adoption opportunities in adoption of modern kilns and their responses. Adoption opportunity as shown in Table 2 was assessed among different participants towards adoption of modern charcoal kilns in the study area. From the total (N=255), different responses were obtained. Majority of respondents 49.8% (n = 127) agreed that the modern kilns were efficient compared to the local assembled earth kilns for charcoal production. The affordability of modern kilns had 75.7% response rate in relation to adaptation opportunity of the modern kilns. Mishra *et al.* (2016) on sustainable charcoal production from biomass argues that cost of modern charcoal kilns is high affecting their uptake. This agrees with the survey that only saw 25% affordability rate in the area.

Eleven percent of respondents supported the fact that modern kilns were accessible in Mutomo Sub-county. However, 5.1% of the participants indicated that there were other adoption opportunities towards uptake of modern kilns rather than their accessibility, efficiency and

affordability. Some of this other opportunities were creation of awareness and capacity building. In adapting to modern charcoal kilns, it was found out that there were challenges being experienced by the respondents as presented in Table 3 The cost of modern kiln is the major challenge to its adoption because 74.5% of the respondents cited it as such. Others are availability and productivity.

Table 2: Adoption Opportunities

Adoption opportunity	Frequency	Percentage (%)
Accessibility	29	11.4
Efficiency	127	49.8
Affordability	193	75.7
Others	13	5.1
Total	255	100

4.3 Perception towards the use of modern kiln

The study sort to establish what the respondents perceived towards the use of modern kiln. Majority, 62.7% (n = 160) of the respondents felt those modern kilns are expensive. 7.5% (n = 19) of the respondents stated that they have a high recovery rate, 5.9% (n = 15) however felt that they are not accessible while 2.45 (n = 6) of the respondents felt that they are labor intensive.

Table 3: Respondents Perception towards the Use of Modern Charcoal Kiln

Perception	(N)	Percentage (%)
They are expensive to build	160	62.7
They are labour intensive	6	2.4
They are not accessible	15	5.9
They have a high recovery rate	19	7.5
They have a low recovery rate	1	0.4
They take too long time	2	0.8
They take shorter time	4	1.6
Total	255	100

4.3.1 Challenges Towards Adoption of Modern Kilns

Table 4 shows three key challenges of adoption from earth charcoal kiln to the modern kilns. From the survey, majority of the participants 74.5% (n = 190), indicated that the cost of modern kilns was a

concern among charcoal producers within the sub-county. This results from materials used, technology and human capacity in terms of skill that is limited in Mutomo sub County.

Availability of modern kilns was another challenge to the charcoal producers as indicated by the respondents. From the total respondents, 14.5% felt that indeed modern kilns were not readily available in the area. Thirdly, the participants saw productivity of modern kilns as a challenge during the survey. Eight point four percent of the respondents indicated that as a challenge. It can be concluded therefore, the uptake of modern kilns is greatly affected by their cost

Table 4: Challenges of Adoption of Modern Charcoal Kilns

Challenges	Frequency (N = 255)	Percent (%)
Cost of modern kiln	190	74.5
Un-availability of modern kiln	37	14.5
Productivity of modern kiln	21	8.2
Total	255	100

5. Conclusion

Modern kilns' technology had majority support from the charcoal producers; however building these modern kilns remained a challenge to some. The respondents' views indicate that affordability was the leading hindrance factor for their uptake. However, despite the cost of the modern charcoal kiln, they are readily available in the area. Therefore, capacity creation and sensitization on charcoal producers will enable penetration of modern kiln technology uptake.

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