ASPECTS OF RESOURCE CONSERVATION AND UTILISATION: THE ROLE OF CHARCOAL INDUSTRY IN THE KENYA ECONOMY

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WORKING PAPER No. 271

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June, 1976

IDS/WP 271

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ABSTRACT

Multi-disciplinary concern has been aroused by the increase of small-scale activities commonly labelled as the 'informal' sector among which the charcoal industry can be classified. This paper aims at establishing the main role of charcoal in the Kenyan economy with comparative analysis of alternative fuels taking price as the arbitar. Charcoal is the dominant fuel used by the low and medium income household in urban and some rural areas. Its use extends to industrial, educationa, commercial and provision of services as a source of energy. Until recently, it was a foreign exchange earner but continues to provide employment opportunities both at formal and informal levels.

The paper also discusses charcoal as a product of limited scarce forest and scrubland resources in Kenya to highlight possible future supply constraints of raw-materials and environmental imbalance. Finally focus is made on some factors controlling charcoal price and trade channels as basis for further research and policy recommendations.

Some aspects of Resource Conservation and Utilisation
a study of the Chacoal Industry in the Kenyan Economy.

1: In Kenya, chacoal in the dominant fuel used by the low and medium income households in urban areas and rural areas where firewood and residues are of limited supply. In the rural areas, however, firewood is more commonly used particularly in areas within neighbourhood of forest reserves and scrubland. The dominance of chacoal utilisation in cities is perpetuated by price in that it is assumed cheaper than alternative fuels than other sources of energy. Its application in the Kenyan economy extends to Institutional, commercial and services as a source of energy plus industrial steam heating. Until 1975, it was on Kenyas export list as a foreign exchange earner while domestically the industry provides income earnings as a source of employment.

The tables below show an estimated chacoal consumption by various sectors and areas for 1975.

I	Sector	Amount - tons
	Household	192,000
	Industry	13,000
	Services	55,000
	Total	260,000

II	Area	Amount - tons
	Nairobi	62,000
	Mombasa	28,000
	Other Towns	30,000
	Rest of Population	140,000
	Total	260,000

Source: Edmond Uhart. Chacoal Development in Kenya: ECA/FOA Forest Industries Advisory Group for Africa.

3. Table 1 shows that about 65% is consumed by household while table 11 indicates that 46% is absorbed by urban areas with Nairobi and Mombasa taking 75% of urban supply.

The role and utilisation of chacoal can be analysed on two basis- household and non-domestic use.

(i) Household - a part from firewood, chacoal is the most utilised fuel by the low and medium income groups while Kerosene is used for lighting purposes. The household expenditure surveys carried out in 1963 and 1975 in Nairobi indicate the following patterns per month per household of 4.5 - 5 persons.

111 Nairobi 1963, Middle income Expenditure pattern.

Item	Shs.
Paraffin	4.10
Chacoal	10.05
Firewood	0.20
Gas	0.70
Electricity	1.70
	16.75

SOURCE: Household Expenditure survey of African Workers in Nairobi - 1963

(Sample covered income grouping ranging from 335-399 shs to 1,000 - 1,399 shs per month)

IV 1974 Nairobi average monthly patterns of Expenditure by income groups (K.Shs)

Item	Income group	0 - 499 LOWER	500 - 1699 Middle	1700+ Upper	ALL
No. of household interviewed		143	230	22	595
gas	--	-	0.97	5.95	1.64
methlated spirit/ Paraffin		3.65	7.20	4.23	5.46
Chacoal	-	9.00	12.35	7.26	10.25
Sturdust Firewood		-	0.04	0.04	0.02
Matches		0.60	1.99	0.76	0.62
Total		13.20	21.17	18.23	18.00

Source: Nairobi Patterns of Expenditure 1975 Bureau of statistics.

The table above indicate that the low and medium groups spend proportionally higher amount of their income on chacoal as a preference to other fuels as it is cheaper for domestic application. In other words its comparative cheapness makes it a most favourable fuel hence increasing the amount of money spent out it. From the expenditure patterns in table IV, it can be seen that more expensive fuels like gas and butane tend to be limited to the higher medium and upper income groups particularly in the big towns like Nairobi and Mombasa.

The dominance of chacoal for domestic use can also be seen in light of price index for various alternative fuels as consumed by particular income groups. The tables below indicate price bases for 1971 and 1975 as an attempt on which to gauge the weights for various items.

V Calculation of lower income consumer Price Index (Nairobi)

Food	Unit	Price base Aug. 1971	July 1975	Weight
Food	Unit			
Paraffin	½litre	0.49	0.90	9
Chacoal	32 Kg bag	9.75	13.87	20
Electri-city	20 Units	24.00	33.60	3
Water	100 gal.	5.00	8.00	13
				45

VI Calculation of Middle Consumer price index

Item	Unit	Price base 1971	1975	Weight
Paraffin	4 gal(Tin)	16.50	20.70	6
Chacoal	32 Kg.(bag)	9.75	13.87	17
Gas-Esso	13 Kg. Cylinder	29.75	43.80	2
Electri-city	20 units	24.00	33.60	10
Water	1000 gal	5.00	5.00	15
				50

VII Upper Income Consumer Price Index

Item	Unit	1971	1975	Weight
Paraffin	4 gal (tin)	16.50		2
Gas 13 Kg	1 cylinder	29.75		7
Electricity	20 units	24.00		21
Water	1000	5.00		18
Chacoal	70 lb.	9.75		5
				53

Source: Table V,VI ,VII: Concepts and Mthodology used in the constructions of Nairobi cost of living indices - Bureau of statistics 1974.

The most important observations from the above consumer indeces are that chacoal has more weight in consumption indices both for low and medium income groups while fuels like gas are never even included in table V since they are rarely used by the groups. In table VII Electricity and gas become the dominant fuels since the higher income groups can afford the items and are most likely to be living in houses fitted with electrical and gas appliances. Though the tables give consumer patterns for only Nairobi, they also give a general impression for other urban areas in Kenya.

In his analysis of the chacoal mostly in Kenya, Henry G.Chlala suggests that the cost of Chacoal and firewood is comparable but on a useful heat basis, chacoal of cost is lower than that of Kerosine, butane and electricity. Hence while the low and middle income groups may consume one or two of the fuels, chacoal remains the cheapest and most utilised. As can be seen in table VIII, In the rural areas, the cost of chacoal and firewood on calorificlve tend to vary. In general firewood will be cheaper in District or locations within neighbourhood of forest wood, scrubland and sawmilling by-products. In areas distant from sources of wood, chacoal still tends to be cheaper due to lower transpotation costs.

VIII Comparative costs of household fuels (Nairobi)

	Firewood	Chacoal	Kerosene	Butane	Electricity
Unit	1 Kg.	1 Kg.	1 Kg.	1 Kg.	1 Kwh.
Calorific value KCAL/ Unit	3,800	6,800	11,500	11,800	840
Approximate Price	15cts	30cts	1/=	2/=	25cts
Thermal efficiency of household appliance	60	75/-	90	95	100

VIII (continued.

	Firewood	Chacoal	Kerosene	Butane	Electricity
Unit	1 Kg.	1 Kg.	1 Kg.	1 Kg.	1 Kwh.
Cost per useful 100,000 Kcals	6/60	5/90	9/65	17/90	30/=
Average monthly fuel cost per middle income household.	14/90	13/30	21/80	40/40	67/50
Rural areas					
Price range per Kg	3-8 cts				
Cost per useful 100,000 K cals.	3/50	3/35			
Average monthly Cost per household	3/60 9/60	8/10 9/20(54 Kg)			

Source G. Chlala. The present stituation and future prospects of chacoal Production and Consumption in Kenya - Industrial survey and Promotion Centre June 1972.

2:2 Probable Future household demand

By the year 1980, the total population of Nairobi is expected to be 1,098,000 people which will be equivalent to 219,600 households (4.5 -5 persons per household). Assuming that less than 20% would be having a monthly income exceeding 1,700 Shs (£ 1092 per annum) who will be likely to use gas or electricity, the remaining 878,400 households will continue utilising chacoal. The present average chacoal consumption is probably 43 Kg per month per household or 516 Kg. per annum. If the remaining households consume chacoal at the same average level, the total demand by year 1980 would reach about 453,840 tons per annum. Mombasa's population is projected to be 447,000 people by year 1980; assuming the same average number of people per household as for Nairobi, Mombasa will have 89,400 households. The chacoal demand for Mombasa will reach 138,570 tons by same year.

The rest of Kenya's urban population (taking the 11 major towns) can be projected to be 571,000 people by same year who will form about 110,200 households demanding about 170,810 tons of chacoal per annum. The future demand for chacoal in various towns will continue to be influenced by their locations in terms of nearness to the source of fuel raw-materials. However,

towns close to forest reserves and major saw-mills such as Nakuru and Eldoret may continue to depend more on firewood and wood residues than chacoal hence lowering the potential demand. Other town however, may consume chacoal to a larger extent than Nairobi owing to higher price of fuel oil relative to their incomes. The third group of urban chacoal consumers are the urban-dwellers particularly in the semi-urban areas, slums and the general low income populance who have no infrustructural facilities such as electricity or gas appliances in their houses.

By 1980, the rest of the rural population will total about 13.6 million and taking an average of 6 people per household, this will be equivalent to 2,800,00 households. It is assumed that the households would be utilising either chacoal or firewood depending on their ecological surroundings. It is already observed however, that even rural families who basically depend on firewood have locally made stooves (jikoos) and chacoal in case they cannot get firewood. Assuming an average of $\frac{1}{4}$ bag/family/Month the "rural' demand for chacoal will be about 305,450 tons per annum. Thus the probable household chacoal demand by 1980 can be summarised as follows:-

Nairobi	453,840	tons
Mombasa	138,570	"
Other towns	170,810	"
Rest of population	305,450	"
Total	1068,670	"

2:3 Non - domestic USES:

(a) Industrial: Chacoal utilisation for steam raising in industrial use needs attention at this stage when fuel oil prices are swelling up. Chacoal substitution could not only act as a means to save on foreign exchange on import of crude oil but could probably lower prices of domestically produced products. Some feasibility studies carried out suggest in areas like Mombasa with oil refinaries, chacoal seems to be more expensive than fuel oil for steam raising purposes when delivered in bulk. The table below indicates that when considered on cahorific value basis, chacoal is more expensive assuming that tonnage Quantities can be made available in large amounts.

	Chacoal		Fuel oil.	
	Nairobi	Mombasa	Nairobi	Mombasa
Per Kg.	28cts	22½cts	33½ cts	25
Per Million Kew	41/10	33/10	32/20	24/25

Source: E. Uhart - Regional Advisor for chacoal F1210.

In areas further away from Mombasa (Further than Nairobi) fuel oil may average 38-40 cts/kg without discount which is equivalent to 37/50 per million K cal; while chacoal at 5/50 a bag would cost about 22.50 for the same heat value. This would then suggest at least theoretically that chacoal utilisation might be cheaper for steam heating in areas far from oil refinary stations.

Further, in a preliminary survey of chacoal industry in Kenya possibilities for chacoal utilisation in cement production in industries like Athi-River cement factories were considered. It was suggested that the factory would need about 2,000 tons of chacoal per month (on 240000 tons per annum) as a replacement of 16,000 tons of fuel oil. The monthly costs of chacoal and oil would be about 760,000 shillings at 380 sh/ton and 622 sh/ton respectively. From these figures, it would again appear that it might be cheaper to use chacoal in cement production than fuel. However, the following practical considerations are of importance as they would tend to make the choice between the two alternatives rather marginal. First more costs would be incurred in converting the industrial structure for chacoal on both chacoal and fuel oil/use It might also require Chacoal Centre for training personnel to acquire industrial skills and possibly with sound knowledge of forestry It would also require setting/up of chacoal laboratory for quality analysis of the chacoal itself and the by-products. In all, chacoal has to be of different quality depending on the industrial application hence its production and storage would have to be considered which would essentially mean more investment in the industrial fixed assets and operational costs.

Chacoal application in such big industries would also require ensurance of continous adequate supply of materials. It would also be clearer chacoal possibly from debarked wood such wattle from Eldoret which was used in Tororo Cement. The problem facing Kenya in fullfilling the above supply

* See ECA/FAO - Forest Industries Advisory Group in Kenya. 1975

will be dealt at later stage as we look at the existing resource potentials. Further pre-feasibility studies in determining the technical and economic viabilities of chacoal utilisation are/still required so as to understand how the industry could play a better role in industrial growth of the country.

Chacoal has been used in small industrial units both in urban and rural areas particulary for metal melting. While, some small-scale industries are taking up to oxy-acetylane flame for their welding, it is notable that a substantial amount of chacoal is still used in urban areas for roasting meat tinsmiths and other activities usually termed as informal.

2.4 Institutional,Commercial and Services:

There are over 8,3000 schools in Kenya; about 10 - 12% one located in Nairobi and Mombasa. We assume that most of the school kitchens burn wood or apply chacoal. Today, the estimated consumption by institutions is about 20,800 tons. It would appear that most schools will continue depending on wood... and or chacoal for future.

The estimation of chacoal consumption can be on the basis of the number and type of restaurants and Hotels in Kenya plus the different types of heating methods. What is evident to day is that most small and medium restaurants still born wood or chacoal as sources of energy. One method establishing the amount of chacoal consumed could be by looking at purchases of the non-food items of which the fuel bill and amount are established. The 1972 Commercial and restaurant chacoal consumption was estimated at 21,000 tons per annum and by using the fuel bill method and the amount bought an estimation of the existing demand could be established.

2:5 Foreign Exchange earns.

Chacoal has apparently been appearing on Kenya's export list until 1975 when exportation was banned by decision from the Ministry of industry and Trade'. The ban was supposedly imposed as a means to conserve the raw-material resources and hopefully allow a period when chacoal industry and trade can be controlled. The effectiveness of the boan is yet to be evaluated as substantial amount of chacoal are captured at Mombasa and Malindi bound for external markets. The table below shows the amount, earnings and market price outside Kenya.

year	amount tons	earnings K£	price shs/ton.
1967	2,500	29,000	253
1968	9,200	105,300	280
1969	22,400	294,000	263
1970	35,800	456,000	253
1971	26,000		
1972	4,900		
1973	12,400		
1974	11,300		

SOURCE: Statistical Abstract 1975

The forest Department, however gives different earnings and prices except that the information given goes up to 1974 in terms of earnings and price per tonnage. The different figures given by government bodies could be an indication of how unplanned and controlled the industry is in Kenya or possible different methods used in recording.

Table XI Chacoal Exports and Transfers.

Year		Quantities	Metric	Value	average price/ton.
1970	Exports	358,264	21,366	9,111,132	511
	Transfers	116,544		9,821,482	
		474,808		10,932,614	
X					
1971	Exports	505,657	26,205	14,555,931	600
	Transfers	76,693		1,181,058	
		528,350		15,736,989	
X					
1972	Exports	43,356	4,951	1, 87,950	459
	Transfers	66,656		1,085,374	
		110,012		2,273,324	
1973	Exports	253,066	12.417	6,262,389	532
	Transfers	22,875		345,827	
		275,941		6,608,216	
1974	Exports	243,548	11,316	7,563,968	682
	Transfers	7,925		164,087	
		251,473		7,728,055	

SOURCE: Table of Exports and Transfers of chacoal anex II forest Department.

Most of the chacoal was exported to the middle East, Kuwait absorbed more than 40% while the rest went to Netherland, European countries, U.K. and West Germany. Smaller amounts went as transfers to neighbouring countries particularly to Uganda for Cement Production at Tororo. As far as the chacoal for export is concerned it is logical to assume that most of it was originating from the scrubland and forest reserves from the coast as transportation costs would make far inland chacoal too expensive and uneconomical for the trade. The FOB price per ton of chacoal in Mombasa is between U.S. $120 and $140 to the Middle East and unless the Quality of chacoal is high enough to capture high export price or transportation costs are reduced, then chacoal from far inland becomes uneconomical to export.

The above figures (table X) indicates an increase in chacoal export Quantities up to the earliest sevenities but also price decline since 1968. The price decline could have been a result of high competition from alternative fuels particulary fuel oil from the Middle East. Moreover, most of the chacoal was from the coastal scrubland processed under traditional methods which is considered inferior to debarked wood chacoal. The price increase particulary in 1974 could have been aresult quality of chacoal since it was the same period when massive destruction of wood both near the coast and inland for chacoal burning was reported. (eg. Naivasha destruction; indegeneous forest clearance within Arobuko-Sokoke reserve near Thila station Daily Nation 14th May, 1976). This price increase could have been also a result of higher energy prices as a result of oil increase.

2:6 Employment:

Finally, the chacoal industry in the Kenyan economy can be seen as source of employment. The official enumeration in 1974 gave the total number Employed as 19791. The table below shows grouped number of employees and the number of enumerated establishments.

1974 - chacoal Employment

XII No of Employees	1 - 4	5 - 9	10 - 19	20 - 40	Over to	Total
		5			19280	19791
No of establishments		5			289	

SOURCE: Statistical Abstract 1974

The above figures are bound to be underestimation of the range of people involved in charcoal industry as the survey covered only employment in the gazetted areas and licenced by the government. The official enumeration leaves out people in the industry operating small-scale units. It is observed from table XII, that there were no establishments recorded employing between 1-4 people, yet charcoal production and marketing has continued informally both in urban and rural areas as a source of Employment involving less than four people. Infact at informal level, it seems the less the number of people (up to 6 using traditional method) involved in small-scale production the more lucrative the business becomes and the more secret the industry becomes from official harassement.

Agreably, data on informal industries may be difficult to come across in that the establishments may not have nor keep systematic recording and may not be officially registered. This accounts for the fact that most enumerations and data analysis in Kenya have concentrated on information pertinent to economic and service sectors in the formal sector which have official recognition while some informal activities are considered illegal. I would not hesistate to suggest that such surveys ignore informal activities and uncontrolled areas where the majority of the urban low income people live produce results biased towards higher income groups as against 'formal sector' livelihood. In short there is urgent need for researchers to involve themselves in factors affecting both the urban and rural informal sector if realistic recommendations and policies affecting the low-income groups are to be attained. Furthermore prospects of charcoal industry Employment creation in terms of logging, transport and marketing operations should be studied particulary if the modern methods of charcoal making are to be applied. i.e. to operate Mark V, it would need 150 workers.

3: Supply (constraints)

Chacoal is a product of the scarce forest and scrubland resources in Kenya hence its increasing demand and trade has evoked concern from various desciplines among which are forest conservants, environmental ecologists, planners, and economists. The Kenya Government has realised the importance of the conservation and utilisation of the resources by stating that "Conservation of the Environment is increasingly becoming important as the population and the impact of development on the capacity of the Environment to sustain the use being made of it. The view taken in this paper is that conservation

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1. Kenya Development Plan 1974 - 1978 pg. 190

of forests and scrubland may or may not be desirable depending on the costs and benifits of the chacoal industry in the economic growth of the country. However, While chacoal consumption goes on, conservation of the raw materials must be pursued as "the wise use of our natural invironment, the final analysis, the highest form of national thrift the prevention of waste and desprilment while preserving,improving and renewing the quality and usefulness of our natural resources".[2]

XIII Land Distribution in Kenya

Type	Area (000^s)	%
Agricultural land	5.4	9%
Forest land	1.7	3%
Range land	26.4	44%
National Parks, Game Reserves, Desert & semi-desert	26.5	44
	60.0	100

SOURCE: Forest Department. The figures are rounded up and include lakes and water areas. 6,675 sq.miles.

From the above table, forest reserves cover only 3% 6,675 sq.miles of Kenya's total land which is considered a low percentage in that this is an exhaustible through renwable resources. There is a problem that at the current rate of demand for chacoal there may not be enough supply of rawmaterials within areas which are gazetted productive forests of Kenya. Further this shortage may be aggrerates by the climatic conditions in that about $\frac{3}{4}$ source of Kenya has not enough rainfall to support wide scale plantations for chacoal production. At the moment one of the problems seems to locate enough space for future forest reserves and infact it estimated that by year 1980 all free land in the forest estate will be planted. The magnitute of this problem can be briefly seen in light of the following example. In order to produce 18,000 tons of chacoal from a reliable and continuous supply, one would require

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2. Desman and Fredrick - Conservation of Natural Resources.p.182

total volume of solid wood amounting to 250,000 m^3 per year. This can be obtained from about 30,000 to 85,000 hectres of tropical forest on a sustained yield of a growth rate of 20m^3 per hectre per annum. This could also be from savana woodland or Eucalyptus plantations of about 45,000 hectres and growth rate of about 20m^3/ha/annum. Questions which arise from above illustrations are whether is would be socially and economically feasible and viable to devote move arable land to chacoal production vis avis other land uses, or whether we can develope some stretches of land usually classified as arid into chacoal productive areas

The second problem concerning supply of the raw-material is the fact that more land cannot be gazetted and controlled by the forest Department as this would encroach on range-land parks and other land uses with the most important being agricultural land for the increasing population. The shortage for such natural raw-material can be evidenced in Central Province where natural vegetation is being cleared at a high rate for agricultural farms. Most of the spicies and woody parts of bush and trees cleared on such farms, though usually considered as useless, are potentially useful for chacoal conversion. This particulary possible with new methods of chacoal burning of metal chacoal kiln named the CUSAB (chacoal from useless scrub and Bush). This conversion however, may not solve the problem of raw-materials since in the long run 'chacoal zones' are converted into agricultural farms.

Another problem is the absence of control of the largest part of chacoal production which goes on in the private forest and estates. Most of raw-material come primarily from private estates, scrubs and trees within the rangeland which is not controlled. In order to get immediate benefits some forest owners sell trees to chacoal producers without consequences of heavy deforestation such as soil and wind erosion particularly in catchment areas in the highlands. This is not to suggest that chacoal production in Kenya is the only caurse of rapid deforestation but rather that its likelyhood in causing imbalance in environmental ecology has reached a stage of great concern. Other activities like bushfires, overgrazing, shifting cultivation and high population growth should also be given attention in such studies of resources utilisation and conservation.

Finally, the supply of raw-materials should not only be evaluated as a matter of replacing indigenors forest with plantation of exotic trees

but also from naturalistists point of views to the costs and benefits of such dying natural vegetation. The destruction of Arabuko-Sokoke forest along the Mombasa-Malindi road is seen as a devastating action against the most important habitat in East-Africa of the potential Extinetion of rare bird spicies and golden rumped elephant. Control of such raw-materials is vital importance in countries like Kenya not only to maintain wildlife habitat but also as a measure towards climatic stability. The forest Department in conjuction with relevant institutions should carry out climatic effects in areas like the Cost/Province before chacoal industry takes toll of the coastal rain forest.

Briefly, the chacoal industry in Kenya should also be pursued in light of policies that affect conservation and utilisation of the resources. The afforestation measures, management and administration of the natural influenced the source inventory and its exploitation hence require through examination. Presently, it seems that there has been lack between 'C 'Conservation' authorities (eg Forest Department, Ministry of Agriculture) and 'utilisation' bodies (Ministry of Commerce and Industry, Power and lighting). while say policies towards afforestation are pursued there has been no specific cordination from; 'utilisation' ministries as to how much wood should be planned for chacoal industry or alternative timber industries.

4: Production & Pricing factors.

Like any other industries, factors of raw-material extraction, handling preparation and marketing have influeance chacoal trade. The traditional methods of chacoal stacks, earth or pit Kilns are the most prevalent in Kenya but modern process and technology is also available though not yet extensively exploited.

The latter process involves several stationary and mobile charcoal Kilns. The designs basically differ in carbonisation cycle period, efficiency, nature and size of raw-materials used. The mobile Kilns e.g. mark V are specifically designed for large size timber while the CUSAB kiln are suitable for large timber while as mentioned earlier, the CUSAB Kiln are suitable for smaller size of wood and unwanted scrob and bush say from clearing scrubland for livesto-k or cropland. Brick and Masonary kilns are available and u utilised in places like Eldoret after saw-dust briquetting.[X]

X Description of CUBAS kiln - see FAO working paper 11 Agp SF/KEN 11 by E.C.S. little 1971.

Despite the existing crave for industrial technological advancement in developing nations, the author feels that complete change to modern machinery in charcoal industry in Kenya requires "afore thought." There is certainly need for investigations into fields like the regular supply of raw--materials if sophisticated machinery has to be introduced and run efficiently. Already there is the scarce of scarcity of both controlled and uncontrolled forest and scrubland as sources of raw-materials and one wonders whether the existing inventory and planned afforestation policies can economically cope with industrial demand. Furthermore, research and feasibility studies could be undertaken by agriculturists, foresters and other related experts on areas which may need clearance for aforestation, grazing and cropping rather than carrying out and hoc policies. The monetary attraction from the industry have reached the magnitude when a man sells his only tree in the shamba or even compound without gauging the ecological and domestic benefits of trees. Introduction of better technology, I hope would then not be an acceleeration of invironmental imbalance under the disquise of improved technology.

4:1 Price: In the analysis of chacoal industry, it is important to consider production costs and price trend as basis for future marketing policy and comparative demand and consumption of other fuel. This paper does not go in detail of the costs and price trends of other fuel which would be of interest for further research. Below are the following government controlled retail prices for 1973 and 1975 in different areas of the country. (The price includes cost of bag)

Place	Price (Shs/bag)	
	1973	1975
Nairobi	11	14
Mombasa	9	14
Nakuru	9	12
Thika	10	12
Embu	8	12
Murang'a	9	12
Kisumu	9	11
Kitale	9	10
Eldoret	9	10
Nyeri	9	10

Place	Price (Shs/bag)	
	1973	1975
Kitui	9	10
Kisii	9	9
Lamu	9	9
Meru		9
Kakamega	8	9
Machakos		9
Kajiado		9
Bungoma		9
Busia		9
Kilifi		9
Malindi		9
Rest of Country	7	8

Source: Price Controller - Legal Notice 136, 1973; 1975 - Ministry of Finance & Planning (Treasure).

The price of charcoal varies from town to town but certainly, it is common practice for dealers to sell at higher rates than the controlled prices. In Nairobi dealers purchase at delivered price of 11/= to 12/= shillings per bag and sell at 15/= to 17/= shillings. Most of the bags, especially collected from the roadsiders, are not weighed but on the average the contents vary between 35 to 40 kg per bag depending on the density of the charccal (charcoal density is about 0.4 depending on the materials and the processing method used) The main costs involve felling, cutting of the wood, labour, londing and transporting to kiln site, royality fee and transportation to the market. The 1972 figures from a contractor in Ngong Forest indicated the following breakdown as against estimated costs for 1975.

	1972	1975
Royalty	1.50	1.50
Labour	3.00	6.00
Transport	1.00	3.00
	5.50	11.50

Assuming that 3tons of wood are equivalent to 1 ton of charcoal costs of production can be broken down further as follows.

Felling and culting	6.00/=
Loading and transporting to Kiln site (60 cts per Kilometre)	0.60 km
Loading and transportation of bagged charcoal (20 cts per kilometre)	
Royalty	1.50/=
Cost of bag	2.00/=

Source: charcoal dealer - Nairobi - West.

The above figures give rough idea of production costs of one bag in Nairobi area but in rural areas near forest reserves and using traditional methods the costs are expected to be lower. There is need however for more information aparticulary on transportation using different modes i.e. railway, lorry, bicycle and heads, plus other costs like Kiln depreciation and other overhead costs. The major transportation costs cover transportation of trimmed wood over a minimum distance where chacoal making can be conviniently carried out and the bagged product to road sides or straight to chacoal deports in urban countries. Taking the 1972 figures, more uptodate figures yet to be established) loading and transportation to Kiln site over (K) Kilometres was estimated at 60 cts per Kilometre and loading and transportation of bagged chacoal was estimated at 20 cts per kilometre per ton of chacoal. Thus assuming a cost of 5/50 per running mile for a 10 ton truck holding about 290 bags of chacoal from Eldoret to Nairobi cost of transport per bag would amount to 3/25. Apart from the fact that transport costs highly influence the price of chacoal, they are significant in consideration of utilisation of alternative fuels like oil with high transportation cost element, e.g. is it cheaper for an industry in Nairobi to use chacoal from Eldoret or fuel oil from Mombasa? Further, bearing in mind that chacoal is still a bulky product, transportation costs should count highly on whether consuming industries should be raw-material oriented on market - oriented in location

Apart from the basic production costs, season and quality of chacoal are other price determinants. During the wet season there is a decline in chacoal supply since production process takes longer (10 to 12 days) while in the dry season the cycle is completed in about 6 to 8 days, dependind again on the method of production and the moisture content in the raw-materials. The quality of chacoal as price determinant is basically dependent on the

type of vegetation and species used as raw-material. Chacoal from trees and particulary debarked species, such as wattle, tend to be of higher quality than chacoal scrub and/ or savana vegetation in that the former has higher calorific value hence fetching higher market value. This point is of primary importance if one is to work out price variations and may be of help in case particular forest and vegetation to be planted or reserved for chacoal production. Further, the quality of chacoal can be based on the production method and storage facilities. While the traditional method seems to satisfy chacoal requirements for domestic use, industrial application requires better quality of chacoal which necessitate modern production and storage facilities using new technology such as Mark V.

4:" Royalty: The effects of royalt on chacoal price and supply may be more difficult to assess than other valued production costs in that rates are imposed only in areas controlled by the forest Department while presummably most of the chacoal production originates from the informal sector particulary on uncntrolled private estates and scrubland. Even when equated with firewood rates, there are are no gazetted rates on royalties as they vary with the spicies and location. The royalty charged on each bag of chacoal is fixed at one-tenth of the rate of 100 cubic feet of stocked firewood and for statistical purposes a bag of chacoal is equated to 100 cubic feet stacked or o.25m^3 of solid firewood. The 1972 and 1975 average rates for particular areas and spicies are stated below.

Table XV: 1972	Nairobi area	Southern Machakos	Nyeri	Coast
	Shillings per stacked M^3 for firewood per bag for chacoal			
Olive & Muhugu	1.50		1	-/40
Other indegeneous	1.20		-/50	-/40
Plantation Fuel	1.20	-/60	-/60	-/40
Shamba and Roadside clearing small softwood thinnings.	=/20			=/20

Source: Chlala ibid.

1975/76 royalties - shs per M^3

Spicie.	Less than 240 mill. mid-diameter	More than 560 mill.
Cupressus spicies	11.94	47.34
Pinus spicies	11.62	46,08
Jupinerus spicies	15.33	43.28

Source: Forest Department.

Apart from the increase of rates between 1972 and 1975; the above tables suggest that rates are highest and of different in places like Nairobi and lowest for the Coast; Even within same geographical region rates decrease a as distances from forest areas to densely populated centres increase. Thus, the present royalty system takes into account transport costs. The question of the intended role of the royalty and how much should be charged has been of much recent concern to the Forest Department but for our purposes we can look at royalty effects on the chacoal industry. First it would appear that any royalty charges effect the cost of living of different income groups. In case it is increased it hits . harder on the lower income groups whose expenditure on chacoal takes a higher considerable share of their earnings. Secondly, a drastic change of royalty in one area can influence the fuelwood demand in other areas and eventually leading divergent chacoal prices in Kenya. Thirdly, changes in rates could mean higher chacoal prices than alternative fuels leading to a shift in consumption patterns of different income groups. On the hand, athe can be royalty increases without affecting chacoal demand as/ long as the alternative cheapest fuel remains cheaper. The above are some of the considerations that researchers and policy makers could pay attention when dealing with the industry.

5. Marketing channels (domestic)

Chacoal distribution from the Kiln moves in stages depending on the producer. The big chacoal burners can sell directly to industries or sell to chacoal dealers eg. wholesalers who in turn sell to retailers in towns. The small chacoal producers because of their low output take chacoal to the roadside where the bigger dealers collect the bagged chacoal and sell mainly in towns. It is also mainly, the small producer who supply chacoal to the rural areas domestic consumption and the surrounding rural trading centres. In short, there are known professional chacoal burners in the rural settlements who burn chacoal for their domestic use while at the same time selling informally to their neighbourhood and nearest trading and market centres without passing through institutionalised marketing systems.

The big chacoal burners and contractors operating in controlled forest reserves have to be licenced and pay other official rates such as royalties. It is however, common knowledge that licenced dealers in controlled areas collect chacoal from the roadsides originating from the uncontrolled areas so as to sell their sales. The distance each chacoal dealer has to transport

From the above table, it can be seen that there has been general increase of official chacoal sales recorded. This could be attributed to general population growth in urban and rural areas in the country with increasing chacoal demand. More to that, the high rate of urbanisation and urban population increase (% per annum) of which the majority fall in the low and medium income groups and are dependant on chacoal for fuel use could be the main cause. The effects of restrictions on chacoal burning in particular areas and the fact that some of the chacoal finds its way in the informal market have/to be established to get accurate figures. One method, however for estimating chacoal supplies entering the market outside government control could be by establishing the total demand and subtracting the legal sales from the forest Department. Attempts could also be made to obtain the aggregate figure from chacoal dealers' accounts though it is an acknowledged fact that many dealers operate one official account to enter sales for tax purposes and another account which is unofficial and possibly only exists in the dealers head.

In all, there is need for further investigation on the domestic and export demand for the product on which future producer incentives and policies could be based. This could for example incoporate the allocation of supplies of different qualities of chacoal to different markets. Further there is need for market reoganisation at the producer, wholesale and retail market as the industry becomes more commercialised.

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