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HOUSEHOLD ENERGY USE AND
TREE PLANTING IN KIRINYAGA

By

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ABSTRACT

This paper examines household energy use, particularly aspects related to wood fuels, and tree planting activities in Kirinyaga District, Central Province. After a brief introduction, the first section reviews general aspects of life in Kirinyaga, such as the population density, environmental and economic structure, and land distribution. Kirinyaga is shown to be characterized by smallholder agriculture, though the nature of it varies according to the district's ecological zones. The second section considers how access to wood and other fuel supplies is governed in Kirinyaga. Access to land, the amount of trees and other fuel materials on one's land, the ability to borrow and to buy fuel, proximity to the forest, the availability of commercial fuels, and seasonality all influence access to fuel. Section three discusses fuel consumption, including the types of trees and other materials that are preferred for use. The fourth section analyzes how the District and central government, as well as the local people, have responded to the need for planting more trees. A short conclusion ends the paper.

HOUSEHOLD ENERGY USE AND TREE PLANTING
IN KIRINYACA

INTRODUCTION

Trees are inseparable from any consideration of attaining basic human needs in developing countries. Besides providing timber, food, fodder, and many other products, trees are a crucial source of household and commercial energy. Wood fuel, in the form of firewood and charcoal, is used for cooking, heating, lighting, and in commercial and industrial enterprises as tea factories, butcheries, tailor shops, and restaurants. The sale of wood fuel is an important source of income for some rural dwellers. Moreover, trees and forests play critical roles in ecological processes and cycles, influencing wind, weather, humidity, soil, water, and thus agricultural patterns.

Recently, the importance of wood energy and tree resources in the development process has been stressed. Wood fuel, a renewable resource, is relatively inexpensive compared to other fuel sources such as imported petroleum. Moreover, given the low incomes and very meagre resources of many rural household it is the fuel source they are forced by circumstances to use. However, the use of tree energy is currently threatened by massive and rapid deforestation throughout the Third World, including East Africa.

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Kenya has not been spared this process, as many Presidential speeches, newspaper accounts, scholarly articles, and the personal and daily lives of many people can confirm.

The present study was intended as a detailed enquiry into the wood fuel and tree planting situation in one locale in rural Kenya. Besides obtaining a comprehensive description of wood fuel production, consumption, and distribution, the research examined the following issues:

1. The impact of land adjudication, expansion of agriculture, population growth, and commercialization of fuel supplies on wood fuel use and tree planting activities.
2. The differential effects of wood fuel shortages on households of varying ecological zones and income levels.
3. The impact of government tree planting programmes and policies among the rural population.
4. The types of local initiatives taken to deal with the problems of wood fuel scarcity and tree planting.

Thus, the research sought to analyze the wood fuel problem within the context of other ecological, economic, and social changes occurring in rural Kenya. The study originally intended to focus on one sub-location of Kirinyaga District, Central Province, but once actual field work began it was apparent that the variety of situations and problems occurring among different ecological zones of Kirinyaga was of more significance than those happening in a single zone. Therefore, the research area was wider to include the entire district.

This paper reviews some of the preliminary findings of the research. It is based on fieldwork done in Kenya between May 1982 and March 1983, with the period spent in Kirinyaga being July 1982 to March 1983. The paper covers three aspects of the wood fuel and tree planting situation. First, how access to wood and other fuel supplies is governed in Kirinyaga. Secondly, the types of tree, plants, and other materials used for domestic fuel consumption in the district. Finally, what the official and local response to the needs

of tree planting have been. The paper considers the relative success of tree planting in Kirinyaga, and its obstacles.

It is shown in this paper that serious wood shortages exist in Kirinyaga, but that a range of problems is to be found among ecological zones and socio-economic groups. Access to fuel supplies tends to follow pre-existing patterns of ecological and economic advantages and disadvantages. Tree planting efforts in Kirinyaga have been vigorously carried out by the government and local people, though even greater efforts will be required to overcome wood shortages.

AREA AND POPULATION

Kirinyaga, Kenya's smallest rural district, is located in the Central Province. The district borders Mount Kenya on the north, Nyeri and Murang'a districts on the west, Embu district on the east and south, and Machakos district on its southernmost tip. Until 1963 the Kirinyaga area formed part of Embu district. Kirinyaga's total area comprises 1,437 sq. kilometers, of which approximately 310 sq. kilometers are classified as forest reserve and national park (the Mount Kenya region).

The district is divided administratively into three divisions. Cichugu and Ndia divisions cover the district's area above the Embu-Sagana road (see map). Mwea division encompasses the lower portion of Kirinyaga. The district is further divided into 10 locations and 76 sublocations. Kirinyaga district headquarters are situated in Kerugoya. Divisional headquarters are located in Baricho (Ndia), Kiaryaga (Cichugu), and Janguru (Mwea). Other important localities are Kutus, which shares an urban council with Kerugoya, and Sagana, a township intersected by tarmac roads heading to Nyeri, Embu, Murang'a, and Nairobi.

The 1979 Census states that the population is 291,000, with a density averaging 200 people per sq. kilometer.

When the forest and National Park area (which are uninhabited except for Forestry Department personnel) are excluded, the density of Kirinyaga's inhabited area is about 259 people per sq. kilometer. However, the district's population is unevenly distributed. Ndia and Gichugu divisions have higher densities, with four of their seven locations possessing more than 400 people per sq. kilometer. In contrast, Mwea division has 139 people per sq. kilometer, including one location averaging only 94 people per sq. kilometer. As will be shown in the next section, the variation in Kirinyaga's population density reflects and is a product of its ecological and economic structure.

ENVIRONMENT AND AGRICULTURE

Kirinyaga district's 1979 Annual Report observed that, "Although not lacking in potential for industrial development, Kirinyaga district is less industrialized compared to other districts particularly in (the) Central Province." The district's major industries are all related to agriculture: tea, coffee, rice, and cotton processing. The well-being of the nonfarm sector, shops and services, depends upon the harvests and market prices received by cultivators. In short, livelihood in Kirinyaga strongly relies on agriculture and how it is influenced by the physical environment.

The 1981 Kenya Statistical Abstract (1981: 98) classifies over 90 percent (98,000 hectares) of Kirinyaga's agricultural land as "high potential". The remaining 10,000 hectares of farm land falls in the "medium potential" category. This classification scheme, based largely on average annual rainfall, underscores the vast agricultural potential that exists in this small district. But such as typology also masks important environmental and economic variations within Kirinyaga. These variations are critical for understanding the nature of resource use and for afforestation planning. By taking into consideration four variables, altitude, average annual rainfall, land morphology,

and mode of land use, Kirinyaga can be divided into five ecological and economic zones: the forest, the tea zone, the coffee zone, the dryland zone, and the Mwea-Tobere irrigation scheme.

The Forest Zone

The forest zone consists of the Mount Kenya area and the relatively small Njukiiri Forest, which is held by the County Council but administered by the Forestry Department. The Mount Kenya forest generally begins above 6,000 feet in altitude. Although largely uninhabited, the forest zone plays important ecological and economic roles in the district. The forest serves as watershed for the many rivers and streams that flow into Kirinyaga's inhabited area. The forestry department allows regulated use of the forest. The indigenous trees, such as the Fedocarpus milanjianus and the Ocotea usamburensis (camphor), as well as forest plantation varieties, pines, cypress, and eucalyptus, provide timber, poles, firewood, and other products to sawmills and permit holders.

The Tea Zone

The upper inhabited area of Kirinyaga is the tea zone, which extends from the edge of the Mount Kenya forest to about 5,600 feet above sea level. The tea zone covers the upper portion of both Ndia and Gichugu divisions. This zone is cooler and wetter than the district's lower areas. The land is characterized by a series of ridges and narrow stream-fed valleys.

The district has over 8,000 growers, with more than 3,000 hectares planted in tea. The average grower possesses 0.26 hectare in the crop (Kirinyaga District Annual Report 1981). Because of its high quality Kirinyaga's tea consistently fetches among the highest prices at the London tea auction (Tea Brokers Association of London, Tea Market Report No. 492, 1982). There are four tea factories in the district, with the Kengaita factory using wood supplied by plantation forests from Mount Kenya as its primary fuel in processing. Dairying is also popular in the tea zone, with graded varieties being

almost exclusively used.

The tea zone is heavily populated. The population density in some tea growing sublocations exceeds over 500 people per sq. kilometer. The density of population is partly reflected in the fact that few indigenous trees are found in this zone. Typical indigenous trees are Ficus natalensis ("mugumo"), Albizia coriaria or A. gummifera ("makurwa" or "mukurua"), and possibly the Tabernaemontana holstii or T. johnstonii ("mwerere"). Deliberately planted exotics, notably the cypress, several eucalyptus varieties, the black wattle (once an important cash crop but now of minor importance) and the Grevillea robusta, have become the most common trees of the tea zones.

The Coffee Zone

The coffee zone ranges from approximately 4,600 to 5,600 feet in altitude. Coffee, Kirinyaga's major cash crop, is grown both above and below this range but it does best within these limits. In a sense the coffee zone is a transitional area between the cool and moist upper zone, with its ridges, and the dry lower zone, with its dusty flatness. Throughout most of the coffee zone rain falls in generous amounts. The yearly rainfall average between 1967 and 1977 for Kerugoya (5,100 feet a.s.l.) was almost 1,500 mm., and in Kiaryaga (4,850 feet a.s.l.) about 1,200mm. Coffee is planted on 7,500 hectares, all of it by smallholders. Almost 50 thousand tonnes of coffee cherries were processed in 1980/1.

Though the coffee zone is also densely populated, many indigenous trees are scattered throughout the area. Among the most common trees are the Cordia africana ("muringa"), the Bridelia micrantha ("mukoigo"), the Markhamia hildebrandtii ("muu"), Croton macrostachyus ("mutundu"), and the Erythrina abyssinica ("mubuti"). Planted trees include the indigenous Croton megalocarpus ("mukindari"), the grevillea, and various eucalyptus and cypress species.

The Dryland Zone

The dryland zone covers most of the lower part of Kirinyaga. Most of Mwea (excluding the Mwea-Teberc rice scheme) and the lower fringes of Ndia are included in this zone. Coffee has recently been planted in its upper reaches, but initial harvests produced poor quality berries. Less remunerative cash crops, namely cotton and sunflower, along with maize and beans, are cultivated. Attempts at tobacco growing have been constrained by a shortage of woodfuel for processing. People of this zone tend to be poorer than their upper zone counterparts. Local (zebu) cattle predominate.

This zone is relatively sparsely populated. Much land remains uncultivated. Rainfall in this area tends to be more erratic, and of course falls in smaller quantities, than in the upper zones. In its upper reaches trees and vegetation are the same as that found in the coffee zone. But as one proceeds into the drier areas Acacia and Combretum species predominate, such as the A. tortilis ("muga"), the C. molle ("murama"), the C. zeyheri ("muraba") and the "mutithi", another Combretum species. These trees are favoured for making charcoal. The Ficus capensis ("mukuyu") and the Croton macrostachyus ("mutundu") are also very common. Trees typically planted in the dryland zone are the Croton megalocarpus, which is resistant to white ants, the grevillea, eucalyptus, and the Cassia spectabilis ("munyukwa").

The Mwea-Teberc Irrigation Scheme

The Mwea-Teberc irrigation scheme, located in the midst of the dryland zone, grows most of the rice consumed in Kenya. Over 3,000 growers, who are officially tenants of the Government, plant more than 6,300 hectares of rice. The scheme is under the management of the National Irrigation Board. The scheme is unlike other parts of the district in that all its population reside in villages instead of scattered shambas. The presence of irrigation water, along with other factors such as the low altitude (the scheme is at about 3,850 feet a.s.l.), combine to create special health problems in the scheme, including urinary and intestinal bilharzia, and high rates of malaria, ascariis, and hookworm

affliction. The scheme was started in the early 1950s and is said to be the largest and most successful one in Kenya.

The mean annual rainfall between 1955 and 1981 at the scheme is 950mm. The historical record contains accounts of the Mwea plains as being a relatively treeless area (until the 1950s Mwea was primarily used by the Ndia and Gichugu people as a seasonal grazing site). Tree scarcity continues in the scheme area. The N.I.B. has not encouraged tree planting because of damage to the rice caused by birds. Deliberate tree planting is limited to individual village plots alone. The Croton megalocarpus and a type of euphorbia ("kariaria"), used for fencing and fuel, are often planted.

To conclude, Kirinyaga possesses several ecological and economic zones, each with its own particular characteristics and development potential. Any attempt at agro-forestry or afforestation must recognize that a homogeneous area of high-to-medium potential agricultural land or a homogeneous small-scale farming system do not exist. The situations and resources of the people living in different zones vary considerably. In the next section it will be pointed out that differences in resources among people living even in the same zone have an important impact on the nature of fuel consumption and tree planting.

THE SOCIO-ECONOMIC STRUCTURE

Kirinyaga is inhabited primarily by two Kikuyu groups, the Ndia and the Gichugu. Culturally the two groups are almost identical, the main distinguishing factor being their accents. Residents of the rice scheme and other resettlement that have occurred in Mwea usually come from the district's upper zones or from different parts of the Central Province, including Kiambu, Nyeri, and Murang'a. Kamba and Embu people can also be found in Kirinyaga, particularly in the dryland zone.

Table 2 offers evidence on the nature of smallholder agriculture in Kirinyaga. In general, holdings are small, with 2.6 hectares (5.7 acres) being the average size. Holding size does vary among the locations, the range being 1.77 to 4.95 hectares (3.89 to 10.89 acres). The larger holdings are found in the Mwea locations. An important consideration when analysing differences in land size between areas is the intensity of cultivation possible. A two hectare shamba with several hundred stems of tea and/or coffee, and a few grade cows (along with a portion of land planted with maize, beans, and other food crops), may be much more financially rewarding than a seven hectare shamba in Mwea. The latter might have only food crops, or several stems of coffee that unduly suffer from lack of water and too much sun. Many low productive zebu cows might graze on a part of the land left uncultivated, containing bush and the local trees.

The data presented in Table 3 on land distribution among sampled households supports the district average given above. The median in column "A", the landholding size where the interview occurred, is between five and six acres. The median in column "B", which includes other land owned or rented by the household, is six acres. The larger holdings in column "A" were almost exclusively from the district's drier areas. In column "B" the largest landowners held land outside the district. The person with 70 acres owned 60 of them in Embu district. Another of the large landowners possessed 25 acres in Meru. The amount of landlessness decreases when the renting or ownership of outside land is considered. Most people who owned or rented other land tended to have it in their same or a neighbouring sublocation. However, some people in the upper zone possessed land in the drier areas. The latter were used mainly for growing food crops, since some of the upper areas can only grow one crop of maize per year (the middle and lower areas grow two crops).

Economic differences are not simply between farmers of different zones, though residents of the lower areas tend to

be poorer. There are well marked differences within agro-ecological zones as well. Table 4 relates the distribution of income from Ritui coffee factory, one of nine factories belonging to the 5,590 member Inoi Farmers Co-operative Society. Ritui, servicing growers in the middle to lower area of the coffee zone, was the first factory built by the Society (in 1956). While the majority of growers received below Kshs 4,000/+, one obtained as much as Kshs 70,489/45. It should be emphasized that Table 4 shows the gross payout; the net payment (after the member's various expenses and deductions made by the Society) is lower. For example, the person with over Kshs 70,000/ ended up with more than Kshs 13,000/ in deductions, so that the net payment totalled Kshs 57,310/05. Nevertheless, the table does illustrate that although incomes tend to be low and similar among most growers, the range between the lowest and highest values received varies widely. Interviews and observations, using visual indicators of wealth such as construction materials for houses and roofing, ownership of production equipment and consumer goods, and related items, confirm this statement.

The question of inequalities is complicated by the importance of nonfarm income as a source of differentiation. Some of the so-called local "tycoons" had smaller shushas than some of their less wealthy neighbours. But they possessed other, more lucrative, sources of income (a well paying salary, a business, rental income, or other means) than farming. Several informants state (and life histories seem to lend strong support) that a person cannot gain wealth by farming alone, but needs off-the-farm income to get ahead. This conclusion has also been convincingly demonstrated in recent studies (for example, see Jaugerud 1981).

Landlessness and land poverty are problems in all parts of the district. All the district's land has been adjudicated, much of it having been done between the mid-1950s and 1970. Table 3 shows land distribution among sampled households. One district official estimated that landlessness affects 10 percent of Kirinyaga's households. Both figures

probably understate the actual amount of landlessness because much of it is disguised. That is, many shambas have several married or unmarried sons living on them, the land being officially held by the father. Probably many, even most, of these sons will inherit very small, if any, parcels of land. Not all eligible heirs can be accommodated given the already small size of holdings. Land division has had an impact already. According to the 1979-83 Kirinyaga District Development Plan, the average size of holding in the district decreased from 4.1 hectares (9.1 acres) to 2.6 hectares (5.7 acres) between 1969 and 1978 (1980: 6). Given the existing rate of population increase, the problems of landlessness and land poverty can only intensify in the future as land division continues.

Many landless people describe their lives as a "struggle". They suffer from irregular employment, chronic cash scarcity, insecurity of tenure (for those who have borrowed or who have "squatted" on another's land), an inability to provide education for their children, and other hardships in securing basic necessities such as water, fuel, and food.

To summarize, Kirinyaga is primarily a land of smallholders. However, differences in landholding exist between ecological zones and among farmers of the same zone. Wealth in Kirinyaga is not solely determined by the amount of land one holds (or related features including the presence and type of cash crop, and husbandry practices), but by the ability to generate off-the-farm income, particularly from lucrative money earners as owning businesses and real estate or well-paying civil service or teaching salaries. Landlessness is a problem and it threatens to become worst in the future. In short, although most people in the district are "smallholders", a considerable range in resource ownership or control is present among households.

ACCESS TO FUEL SUPPLIES

Throughout Kirinyaga there appears to be seven factors that govern access to wood and other fuel supplies: access to land; the amount of trees, bush, and other local fuel materials one possesses; the ability to pay; the ability to borrow; proximity to the forest; the availability of commercial fuels; and seasonality. These factors are discussed in detail below. The basic argument presented in the following sections is that these factors work separately and as a group to create a situation whereby access to fuel supplies in the district is highly unequal. Moreover, this inequality follows and reinforces other existing economic differences among households.

Access to Land

In a primarily agrarian economy as Kirinyaga access to land is critical. Except for a handful of people who have substantial non-farm incomes, very few residents of Kirinyaga can afford to be without land. Yet, as already mentioned, landlessness is a problem in the district. The landless pay dearly in terms of cash, time, and hardships for their lack of this basic resource.

The landless tend to reside in the villages and towns. At Karairi, Karia, Baricho, Murabara, Sagana, and other places, landless women complained about having "no proper place to gather wood," or needing "to roam along the road" in search of twigs and small pieces of wood and shrub. Collecting enough wood is a time consuming "headache." Their supply of fuel is irregular and tends to be expensive if purchased.

The landless "cope" with their predicament in several ways. Some are fortunate enough to borrow or to hire land. Besides providing food, this land and its hedge boundary might also provide fuel. Others utilize what they call "ownerless land" (usually vacant County Council or other government plots of land) where "no one can ask questions." For example, at Baricho and Mithigaing the landless and land poor gather bush and wood at certain unoccupied places along

a river bank. Borrowing firewood, cooking "light foods" such as ugali and rice that do not require much fuel (but which tend to be costly), buying fuel, and simply going without fuel for one or two days, particularly during the long rains, are also common means of dealing with fuel scarcity.

People in all parts of the district contend that firewood scarcity began with land adjudication. Before the official privatization of land people freely gathered from the bush. Prior to adjudication much of Kirinyaga's land was divided among clans and among families within the clan. Those who were recognized as having rights in a certain piece of land had exclusive rights over the trees, but others could freely collect from the bush whatever they needed for fuel. The amount of land cultivated was much less than it is today, so there were many places where one could fetch fuel if their own parcels lacked trees or bush. Furthermore, many of the older residents claim that there were many more of the indigenous trees than one finds today.

The demarcation of land ownership began in Kirinyaga during the 1950s, in the midst of the Emergency. People stressed that access to land became restricted immediately with the handing out of title deeds. A woman in Nyangeni sublocation said, "Each got his own piece of land which he was supposed to take care of. People did not want intruders on their land." "No one could go on another's samba," observed an old landless woman in Sagara, "It was trespassing." Another elderly woman, from Mahigaini village, commented, "If I go to the places where I used to collect firewood I can be chased out by the owners." Today all land in Kirinyaga has been demarcated, and with it a permanent class of landless people created.

The Amount of Trees and Other Fuel Materials

Access to land alone does not guarantee one of having sufficient fuel. With the pressing need for cash and food crops, building materials, woodfuel, especially given the rapid growth

in population, it is not surprising that much of the bush has been cleared from the district's inhabited areas. Uncultivated bush areas are found mostly in the sparsely populated, dry marginal areas of Mwea such as Murinduko and Rukanga. Some households dated the beginning of fuel scarcity when they had cleared all the bush from their land. Between Mururi and Difatha, for example, one household with about 3.6 hectares said its fuel problems began in the early 1970s when they brought all their land under cultivation. Only after the bush was gone did they start to plant trees. Another household in the same area with about 4.5 hectares reported that it first experienced firewood scarcity in 1981 after all its land was cleared. Thus, even in some of the drier areas problems are starting to be encountered as the bush is removed for agriculture. On many shambas tree planting does not begin until all, or almost all, of the bush is gone.

Besides trees and any "bush" areas, an important household fuel resource on shambas is the boundary hedge. Plants such as the lantana ("mucimoro"), the Plectranthus barbatus ("muigoya"), and "kariaria" (Euphorbia spp.) that are used as property markers are also a ready source of fuel. Perhaps the best quality of the hedge plants is their convenience. When fully dried some of these shrub ignite quickly and are favoured when a rapid fire is needed. The lantana is particularly used by households. In fact, the lantana has become widely distributed throughout the district, growing wildly in thick clusters.

Though tree planting activities will be discussed later in this report, the importance of tree husbandry practices in determining the amount of fuel material available needs to be stressed. The lack of tree planting by many households, at least until recently, led to the steady deforestation of the district's inhabited zone. Among households with very small holdings there is sometimes a reluctance to plant trees. They feel that all the space is needed for food and cash crops. "Coffee pays out school fees," said a woman near Kibingo, "If we plant trees near the coffee the shade might hurt the harvest." This woman vehemently complained about having to use her thorny "mubage" (Strychnos spinosa) hedge for fuel and spending precious money on wood and paraffin. She thought her land (over one hectare) too small to risk damaging her crops. Others throughout Kirinyaga say, "Those with little land don't plant trees." Therefore, land poor households who suffer fuel problems similar to those of the landless often feel too constrained by their land poverty to attempt any tree planting.

Ability to Pay

In Kirinyaga, fuel, in the form of wood, shrub, crop residues and cow dung, is sometimes a "free good." That is, people are able to gather it, either from their own or some other land, without having to give money or some other good in exchange. But fuel also exists in the district as a commercial commodity, and access to it is determined by one's ability to pay. Indeed, with paraffin and gas, which are imported and industrially produced, all access is governed by commercial exchange. Wood

and charcoal are also commonly sold. In a sample of 205 households, 147 households (72%) reported buying wood or charcoal.

A difference in the buying situation occurs between relatively prosperous and poor households. The wealthier households can afford to purchase appliances that require commercial fuels, such as gas cookers, refrigerators, paraffin stoves, and various lamps. For many of these households buying fuel is a matter of consumer preference, as in the use of cooking gas. People at the poorer end of the economic spectrum confront situations, such as the long rains or harvest time labour demands, plus a chronic resource scarcity, that forces them into the marketplace to obtain fuel.

Those who are able to purchase imported fuel, paraffin and gas, also tend to keep using locally based fuels. This is a response to the relatively high cost of imported fuel and to their frequent lack of supply. There is a strong sense among many of these households of how much different fuels cost, and they pattern their fuel consumption accordingly. Near Kagio, one household reported using gas and paraffin to cook light foods (ugali, rice, porridge) and charcoal and firewood to for other uses. In Nyangeni one household said it used gas when the children were away at school or when something had to be cooked in a hurry. Otherwise the cylinder would not last a month. She used charcoal for cooking light foods and firewood for cooking foods that required lots of fuel (including maize and beans). Since her shamba had insufficient trees (she had planted many Grevillea robusta but they were too young to prune) the woman purchased about half of her firewood needs. Gas was purchased in Kerugoya, while paraffin was obtained in Kutus.

Wood remains a popular fuel because it costs less than its alternatives. Nevertheless, for poor households, particularly in certain areas of the district, buying wood can be expensive. A person may earn only between KShs. 10/= to KShs. 20/= per day doing shamba labour, then have to pay KShs. 10/= to KShs. 12/= for a load of wood that lasts only two or three days. Such relatively high costs drive the fuel poor to roam

along roads, paths, and "ownerless land" in search of firewood that only involves the spending of their labour to obtain. Sawdust is gaining popularity as a fuel (used in jikos) because it can be obtained for free, or at a very low cost (about KShs 2/ per sack.)

Ability to Borrow

As a response to immediate fuel scarcity, and in order to curtail cash expenditures, many households borrow fuelwood from one another. In 101 of 205 interviews (49%) households mentioned borrowing or lending firewood. People borrow from neighbours who have large parcels of land with trees and bush, and from those who simply happen to have a large supply of firewood that day.

Friendship plays an important role in fuel borrowing. People borrow from neighbours who are on good terms with them. "If I go to friends they can't refuse," said a man at Mathangauta village. "If a neighbour is an enemy then you do not borrow from them," said a man in Mururi. Near Sagana some women stated that when they intended to borrow wood from a friend they bring along some maize and beans to give them, but when the person is not a friend they "must bring cash."

The borrowing of firewood seems to be part and parcel of the exchange of favours, goods, and labour that occurs between households that are friends or related. A household that borrows one day may lend on another. People try to borrow from a number of neighbours. "I can't go to the same one," a woman said. Some people borrow only in time of dire need. At Kagio some people said they prefer not to borrow firewood but do so when they have no alternative. Where fuel is especially difficult to obtain for a household it will not lend any. One woman in Ndimi sublocation asked how could she let someone borrow what it took her hours to collect.

When a landowner wants to clear the bush off his land he frequently invites his neighbours to come and cut all they want. Around Gatithi many households that are otherwise fuel short are able to get all the lantana and other shrubs they need from a neighbour who is clearing his land. Sometimes a household will rent the bush portion of its land to a neighbour, allow them to clear and farm it for one or two seasons, then reclaim the land. Finally, a household might decide to clear off the bush itself and sell the wood and shrub to their fuel short neighbours. Thus, the demand for agricultural land hastens the bush's conversion into fuel, and in the process the bush sometimes almost becomes a neighbourhood resource.

Proximity to the Forest

Proximity to the forest (mainly Mount Kenya but also Njukiini) is an important variable in terms of access to and cost of fuel in Kirinyaga. People who live near the forest are able for a small monthly charge of KShs. 4/= to gather one load of firewood per day. The Forest Department collects the fee and supervises the gathering of the fallen wood (trees cannot be cut). For these people the cost of wood is relatively cheap except for their own labour. Their only inconvenience is transporting the wood, particularly during the rainy season. Some families will gather a week's worth at one time and load it on an oxcart that waits at the forest's edge. Daily loads are generally carried on the back.

Those people in Kirinyaga with relatively the most money earned in agriculture, the coffee and tea growers who live in the upper zone, pay the least amount for their firewood. The lower zone residents, with generally lower incomes, have to pay higher prices. For example, a lorry load of wood costs KShs. 700/= at Guama sublocation, in the tea zone, while at Matandara village in the Mwea rice scheme a lorry load of wood costs KShs. 1,400/=. People who live away from the forest must buy wood from neighbours, vendors, or sawmills at much higher costs. A four shilling load of wood may last only one to three days.

For the most part wood is transferred from the upper zone forest to the lower areas of Kirinyaga. Within the lower zone there is some lateral movement of wood and charcoal from the dryland bush areas into the Mwea rice villages. Even in Mwea, though, many wood dealers are supplied from the Njukiini forest or Mount Kenya.

Availability of Commercial Fuels

Another factor determining access to fuel supplies is the availability of commercial fuels. Sometimes the demand is present but the supply is absent. Paraffin is the preferred fuel for lighting by almost all the households in Kirinyaga (the exceptions being those that use electricity). But many times people must use firewood or candles because of paraffin "famines". The shortages of paraffin and gas that swept Kenya in December 1982, for example, were strongly felt in the district. Temporary shortages of paraffin and gas are perennial problems in Kirinyaga.

In Sagana charcoal vendors complained about the irregularity of supply. Although the town is on major intersection of tarmac roads many charcoal filled lorries by-pass the vendors on their way to Nairobi and other places. Said one vendor, "We say 'Thank you to God' for the ones that stop." The vendors said there was no proper lorry with a schedule that visits Sagana. The vendors believe that the charcoal lorries come from "Nyahururu and the Rift Valley." They said that people in the Sagana area do not make charcoal because of the scarcity of trees.

People who rely on buying trees from their neighbours sometimes find that none are available for sale. This occurs mostly during the wet season.

Seasonality

A final influence on access to fuel supplies is seasonality. As in the other factors that have been discussed, seasonality combines with the socio-economic and ecological structure of Kirinyaga to produce a situation where fuel scarcity becomes a greater hardship for some than others. People commonly

mentioned the long rains as the most difficult time of year, with 171 of 209 households (82%) reporting they had problems obtaining enough firewood. The short rains (October- November) was not as critical a period, with 97 of 195 households (50%) saying that they had problems. Common problems include difficulties in fetching wood because of muddy paths and roads, wet trees and shrubs, and the unavailability of commercial fuels. Many households store wood ahead of time, at least to carry them through most of the wet period. But the landless and land poor, plagued by chronic land, cash, and fuel scarcity, are unable to accumulate wood to cushion against the travails of the long rains.

Around Mwea some people stated that the rice planting and harvesting times are when fuel scarcity also becomes critical. Two women who do wage labour for the rice tenants said they might work so late that they are unable to gather or to buy any fuel for the night. "We have money but we can't eat money," one said. Another person said that when a woman had to work late in the paddy she would miss collecting cow dung, a fuel sometimes used in Mwea.

FUEL CONSUMPTION

Firewood is the dominant household fuel used in Kirinyaga, of a sample of 540 households, 535 (99%) reported using firewood in cooking. Though 101 families (19%) in the sample said they used charcoal, and an identical number said they used paraffin, the numbers stating that these were their dominant cooking fuel source were lower. Only 21 households (4%) said that charcoal was their common cooking fuel, while 15 households (3%) claimed it was paraffin. A total of 19 households (4%) used gas, with 8 (1%) stating that it was their primary cooking fuel.

The dominance of firewood is also demonstrated when examining the devices used for cooking. In a survey of 444 households, 438 households (99%) reported using a three-stone fireplace in cooking. The number possessing jikos* and stoves

*Jiko - metal device used in cooking with charcoal.

were higher than the number actually using them. 143 households (32%) had jikos, and 122 households (27%) had paraffin stoves. 19 households (4%) said they had gas cookers, repeating the same pattern as paraffin and charcoal. Most households cited the high cost of fuel as their reason for not using stoves, cookers, and jikos.

Paraffin is the preferred fuel for lighting, but firewood is a frequent substitute, along with candles. One reason for this substitution is the periodical paraffin shortages. Another reason is that a household may lack money to purchase some. In all, 189 households (97%) in a sample of 193 said they had difficulties obtaining paraffin. Nevertheless, in a sample of 211 households, 208 (99%) used paraffin, while the other 3 households (1%) used electricity.

Table 5 lists the most commonly mentioned trees, plants, and crop residues used in Kirinyaga. Crop residues are an important fuel source, with maize cobs and stalks, coffee prunings, pigeon pea stalks, cow dung, tea prunings, mango prunings, and sunflower stalks being used to varying degrees. Other crop residues reported in interviews were cotton plants, sisal, rice husks, the outer cover of beans, tobacco stalks, and the prunings of several fruit trees. Shrubs used in fencing or growing wildly are also widely used, such as the lantana, the Euphorbia tirucalli, and the Strychnos spinosa. Exotic trees, notably the Grevillea robusta and several eucalyptus varieties are more commonly used than their indigenous counterparts. Among local trees the Croton megalocarpus, Cordia africana, Croton macrostachyus, Bridelia micrantha, and Markhamia hildebrandtii are the most popular.

Preferred versus actual use of firewood and crop residues is contrasted in Table 6. Three exotics (grevillea, eucalyptus, and wattle) lead the list of preferred trees, closely followed by the indigenous Croton megalocarpus. The Combretum molee is the most popular of the dryland trees. All the dryland trees (the C. molee, Combretum zeyheri, Azanza garckeana, and Piliostigma thonningi) tend to be used far below their preferred ranking. Maize cobs and stalks, lantana, Euphorbia tirucalli,

and using firewood to cook staple foods, including beans and maize.

TREE PLANTING

"In the heart of Kikuyu, except for a sacred grove here and there, scarcely a tree remains."

W. Scoresby and Katherine Routledge,
With a Prehistoric People: The Akikuyu
of British East Africa. London, 1910,
p. 6.

"Attitudes towards forests sometimes take on cultural shades... In Kenya, the Masai practice range management, while the Kikuyu cut down trees to grow maize."

The World Bank, "Sociological Aspects
of Forestry Project Design," 1980, p. 23.

The Kikuyu have a reputation in the ethnographic and, it now seems the development literature as a tree cutting people. Such notoriety is supported by the historical record, because the predominant trend in Kikuyu settled areas has been for people, crops, and livestock to re-place forest and bush. Nevertheless, Kikuyus were not directed by some cultural, ideological, or actavistic force to chop down every tree in sight. Instead, the clearing of the forest was an economic necessity in order for an agricultural and pastoral people to subsist off the land. Forest destruction, though, was not without environmental and economic repercussions, many of which were and are negative.

Much has been written about the Kikuyu's custom of preserving certain groves of trees because certain species were considered sacred. At the National Archives in Nairobi the "Embu Political Records, Part II" lists over 200 sacred grovers in the Kirinyaga area (unfortunately the list is not dated). Among the species considered sacred were "mugumo" (Ficus natalensis or F. thonningii), "mukuyu" (Ficus capensis or F. sycomorus), and "mururi" (Trichilia emetia). Many of these trees are to be found throughout the district today, having been spared the axe even though many of the beliefs and practices associated with the trees are no longer adhered to.

Kikuyu tree planting practices are less emphasized in the literature. These agriculturalists were not unaware of how trees grow, and they deliberately planted trees for their own uses in the past. Leakey (1977: 1305), for example, mentioned that the Markhamia hildebrandtii and the Cordia africana were commonly planted as boundary markers and to provide shade.

During the colonial period the British encouraged tree planting. In a letter from the District Commissioner of Embu district to the Senior Agricultural Officer of the Central Province, dated 1st February 1947 (from file no. AGR: 11/3/5/IV, Embu), the D.C. wrote that (... tree planting is particularly satisfactory. Few if any areas of this district are short of trees yet they are planted far more here than any other district I have been in." In the same file a "Half Yearly Soil Conservation Report, July to December, 1946" stated that during the covered period 56,768 trees were planted in Ndia division, while 3,399 were planted in Kichugu (now Gichugu) division. The January to June, 1947 report listed 15,595 trees as having been planted in Ndia and 28,036 trees planted in Gichugu. The 1946 Embu district Annual Report observed that "It is very noticeable in comparison with neighbouring Kikuyu reserves that the natives of Embu are much more tree conscious than their neighbours. Parts of the district have rather too many trees for good agriculture, yet there is a strong dislike of removing any even in these areas. The number of exotic trees to be seen too, is much greater than in neighbouring districts." The Local Native Council operated 10 tree nurseries that year, several of which were located in what is now Kirinyaga. Wattle growing had been promoted as a cash crop in the upper areas since the 1920s.

Not everyone remembers tree planting during the colonial period as being a pleasant activity. Some informants complained that the wattle and eucalyptus trees were "bad for crops." A man who was an assistant chief during this time said, "People came to hate the mubau (eucalyptus) because they said it consumed a lot of water in the garden." Some people refer to the eucalyptus as minyua mai, "the one that takes all the water." To some extent tree planting was associated with the many unpopular soil conservation campaigns.

In the early post independence period, and in the wake of land adjudication, some households said they planted trees, but many did not. Interview respondents said that they "did not know the value of trees." They felt the bush "would be sufficient." Some families stated that they began planting trees in the mid-1960s and 1970s after firewood became difficult to obtain from their own shamba. Around this time bush clearing accelerated as more land was placed under cultivation. The minutes from the Kirinyaga County Council's Agriculture, Land, and Forest Committee meeting of September 14, 1966, mentioned that, "... many people were experiencing difficulties in obtaining firewood...." The Committee encouraged tree planting.

The popularity of tree planting increased steadily during the 1970s. A March 1970 Monthly Report, Forest Department, Embu, stated that, "A lot of people have been flocking to Njukiini nursery requiring planting stock of *Grevillea Robusta*." A worker at Njukiini nursery said that the demand for seedlings started to increase heavily around 1976.

One district official said that when the government began telling people to plant trees few people listened. The only tree planting going on in the district was by those who were taking their own initiative. The rest "never took tree planting seriously." As the President's and the government's requests to plant trees became stronger, and as the shortage of trees became more apparent, people started listening. "Then the message caught the people like a fever. People went out and started to plant trees. We (the government) were caught unaware. We couldn't meet the demand at the nurseries. Next year we will plant many more trees."

Tree Planting: The Official Response

Another district official interpreted the beginning of tree planting differently, "This district was headed towards serious problems. If we hadn't told people to plant trees there would have been severe difficulties. Even now the danger has not passed." He emphasized that the government's actions have been critically important in promoting afforestation in Kirinyaga.

That afforestation and related issues such as soil conservation have received increased government attention is indicated by the district Annual Reports. A 1966 report mentioned that a soil conservation campaign had "met with a great deal of opposition from the public." The issues of tree planting and soil conservation received little attention until 1977, when it was reported that the district had a "very big" afforestation campaign and that 46 hectares of trees were planted. The 1978 report said that people were beginning "to take soil conservation measures more seriously than ever before." That year a "Rural Afforestation Extension Scheme" was launched,

... to encourage farmers to plant more trees on their farms, to educate school and private individuals on the importance of trees either as fuel, timber, shade and other amenities..." (Kirinyaga District Annual Report 1979: 22)

1979 went on to state,

The response to afforestation in this District has been very encouraging and the wananchi have really adopted the theme of trees are as important as the agricultural crops (ibid p. 22).

Both the 1980 and 1981 reports stated that considerable attention was being given to afforestation and soil conservation.

Perhaps the strongest indicator of the government's commitment to tree planting is the rapid growth in the number of nurseries. Today in Kirinyaga there are 16 publicly owned tree nurseries in Kirinyaga (excluding coffee, tea, and fruit tree nurseries). Two are plantation forests, with a capacity for 500,000 seedlings each. Located at Thiba and Njukiini, these are maintained by the Forestry Department. Four nurseries, each with a capacity of 250,000 seedlings, are maintained under the Rural Afforestation Extension Scheme. These nurseries are situated in each divisional headquarter and at Kerugoya, the district headquarter. The other ten nurseries are at the locational headquarters. These "Chief's nurseries" were created by the Presidential directive. The nurseries have a capacity of 100,000 seedlings.

Tree seedling production and distribution from the R.A.E.S. and five locational nurseries financed through the District Development Committee fund from 1980-1982 was as follows:

<u>Year</u>	<u>Sold</u>	<u>Free Isses</u>	<u>Total</u>
1980	114,174	103,350	217,524
1981	140,617	73,835	214,452
1982	294,723	200,594	495,317
<u>Total</u>	<u>549,514</u>	<u>377,779</u>	<u>927,293</u>

Source: "A Brief Account of Major Development Programmes and Projects in Kirinyaga District for the 1982 Provincial Development Committee Meeting," District Development Office, Kerugoya, 1982.

An additional 146,741 seedlings were distributed from the other five locational nurseries. The plantation nurseries generally produce seedlings for meeting their own planting needs, but some sales are made to local farmers. The R.A.E.S. and locational nurseries were started in the late 1970s and early 1980s.

A nursery is owned by British American Tobacco and is located in Sagana. The B.A.T. nursery operates in conjunction with the Ministry of Agriculture in order to provide firewood for tobacco processing. Within Kirinyaga there were about 171 growers with 82 hectares of land planted with tobacco during the 1980/81 season. Tobacco farming has been occurring off and on in Kirinyaga since the 1930s. During the 1970s the industry was continually constrained by firewood shortages (wood is used in the curing process). In the 1979 season only those growers with enough wood on their land were able to plant tobacco. The nursery, started in 1979, distributed 120,000 seedlings during the long rains in 1981. Tobacco growing takes place in the dryland area near the Sagana-Embu road.

Another example of government encouragement of afforestation is National Tree Planting Day, extended into National Tree Planting Week in 1982. This event has occurred every year since 1964 when Jomo Kenyatta planted a "mugumo" tree at Uhuru Stadium to mark the place where the Kenyan flag was first raised on Independence Day. Ceremonies have been held at the district headquarters and other places throughout Kirinyaga. Up to 10 tree seedlings are issued free of charge on that day. The Day centers attention on the value of trees and the need for planting and conservation.

On the whole, the district and central government appear to have made a sincere and fruitful effort at encouraging tree planting. The public is increasingly becoming aware of the importance and value of tree planting. Evidence of tree planting is visible throughout Kirinyaga. Many people attributed their tree planting to the many requests made by President Moi and other public officials. A woman near Difatha pointed to the many grevillea and other trees she had planted, saying that when "Nyayo" (President Moi) drives by he would see that people have been following his wishes.

Some of the landless were critical of the lack of any perceived attempt by the government to help them with their fuel scarce situation. "Those with land don't understand our problems," one said. They felt as if they could not talk to local officials about their problems. The subchief "would think I was crazy" another person said, if she told him she was having difficulties getting fuel. "He would tell me to look for a job to get money to buy some," she commented. Others felt scared to approach any other district official about the fuel problem. But they are waiting and hoping for help. Many say that they would be ready to do whatever the government told them to.

TREE PLANTING: THE LOCAL RESOURCE

Considerable tree planting by the local people has taken place in Kirinyaga. The majority of people are aware of the importance of trees. Many complain that there simply are not enough seedlings available at nurseries during the planting season. In many ways tree planting efforts could be called successful. Nevertheless, there are still many many obstacles to tree planting, particularly among those who are land and water scarce. Increased tree planting will not necessarily increase access to fuel among the landless. Finally, the tree planting that has taken place is probably still insufficient to meet existing and future demand. With the rapid growth in population, the demand for wood-- not only for fuel, but for building and other uses-- can only increase. Considerable and increased efforts by public and private groups and individuals are required to avoid future wood famines. The economic, political, and environmental costs of such a possibility are extremely high.

Table 7 presents the tabulated results on the type of tree planted by 340 households. The Grevillea robusta is the most popular. Prunings from the tree can be used for firewood, while it also yields a good timber for building. The grevillea is compatible with food and cash crops, the local people saying that its shade is not harmful. The tree is also relatively fast growing. The eucalyptus varieties, particularly the E. saligna and E. paniculata, are popular. Besides their rapid growth, the eucalypts can be coppiced several times. A drawback with these trees, especially the E. saligna, is its tendency to absorb a lot of water, thus people frequently say the trees does not mix well with crops. However, many times people will plant it along the banks of streams or other moist areas. The Croton megalocarpus, an indigenous tree, is resistant to attacks by white ants and therefore does well in the district's lower areas where these insects are a problem. It burns well and can be made into charcoal. The cypress tree is often planted as a hedge, and, like the pine, appears to grow best in Kirinyaga's upper areas. The wattle is another upper zone tree, its primary uses today being firewood, making charcoal, and supplying poles for building. The sale of wattle barks continues but on a very small scale. The

jacaranda, as with the Nandi Flame and other trees, seems to be grown mainly as an ornamental tree. Though its timber is said not to be good for building, its branches can be used for props on crops like tomatoes and its wood for fuel. The Cassia spectabilis appears to be a recently introduced tree that grows best in the middle to lower zones.

The Cordia africana was one of the local trees whose planting was encouraged during colonial times. The tree has a strong and attractive timber, typical uses' included beehives, stools, and doors. Planting of the C. africana nowadays involves the replanting of seedlings that have germinated naturally. The same process is used on the other local trees, including the Croton macrostachyus, Bredelia micrantha, and the Markhamia hildebrandtii. The Croton megalocarpus and the Grevillea robusta are also planted at times in this manner. People will allow their neighbours to come and transplant the naturally regenerating seedlings. A number of people have created their own tree nurseries using this process.

People plant trees for a variety of reasons. The most important are to provide timber, poles, and firewood. Given the high cost of timber today a strong incentive is present. Rain attraction is also widely cited. Using trees for fences, boundary markers, and wind-breaks are further reasons why people plant trees. Some have planted trees in order to sell them in the future. Others are motivated by a desire to beautify their homes, have shade, and have privacy. A few people said they planted trees for the good of the nation or future generations, or because they have been urged by officials ranking from the President, to the Rural Forester, to the Sub-Chief. Finally, trees are planted because they prevent soil erosion.

Landholding size has an impact on tree planting, but the relationship is complex. Those with very small holdings (less than two hectares) often complain about the lack of space for tree planting. Yet in several of these households even over 100 trees have been planted, around the boundary, in groves, or near the home. Among larger holdings, especially in the dryland

zone, people do not plant trees at times because they have enough local trees to meet all their household requirements. In general, a smallholding cannot accommodate as many trees as a larger one could, but there is much variation among individuals.

Perhaps one indicator of the popularity of tree planting is the intense competition for seedlings found at the nurseries during the long rains planting season (April to June). One person described it as a "war". At times the number of seedlings anyone can take is restricted to 50. Competition for the popular varieties such as the grevillea and the cypress is very strong. Indigenous trees, except for the Croton megalocarpus, are not too popular; they are said to be too slow growing and too delicate. Many popular varieties are quickly sold out. People complain about travelling a far distance to the nursery only to find all the grevillea trees gone.

One government official respondent to a question about the seedling shortage by saying that much greed and waste were to blame. Farmers know there is a great demand for seedlings, so to be sure of having some they go and try to take home all they can. Frequently they return with many more than they can plant or properly care for. The result is many seedlings are never planted, and the ones that are, often neglected. "If every farmer cared for each seedling he got," explained the official, "there would be no shortage." Nevertheless, the demand for tree seedlings is so strong it would probably outstrip supply. As mentioned earlier, some people have their own small nurseries where their planting stock is developed. Under the Rural Afforestation Extension Scheme people have been encouraged to create their own nurseries.

Another indicator of how popular tree planting has become is that the theft of seedlings has been reported throughout the district. A man in Nduini sublocation had planted 400 seedlings along his boundary, only to find that 30 were stolen "by neighbours". At Mugamba Ciura sublocation a woman who had planted grevillea trees on her boundary came home one afternoon and "met the hole but no tree." About 15 had been taken. People who own

two parcels of land are often reluctant to plant trees on one piece of land is a distance from their home. The reason given is usually that if no one is present the seedlings will be taken.

Data on tree planting survival rates has not yet been tabulated, but it would appear that there is considerable variation among ecological zones and among individual farmers. The drylands zone rains tend to be more erratic and of course falls in smaller amounts than the upper zone. Tree planting in the lower zone during the short rains is often a failure. White ants are a problem in the lower zone as well. Other problems common throughout the district include too much or too little rain, livestock eating seedlings, moles, and neglect of the young trees. Still, some farmers are able to achieve very high survival rates.

The landless tend to be the "odd man out" in terms of tree planting. By definition the landless lack their own land to plant trees. Many, though, do have small plots where their homes are located. On some of these parcels maize, bananas, and other food crops are planted. A woman at Kiaritha village explained that people there do not like to plant trees-- even if they desire them-- because of potential disputes. She said that if one cuts or prunes a tree and it falls on another's property causing damage, which is easy given the small quarters where people reside, then a quarrel can erupt. "People will even go to the subchief." Because of this the woman said that tree planting is a "headache." She once planted trees but cut them down after they reached four to five feet tall in order to avoid any potential grievance. Some landowners have given similar accounts of neighbours who pressured them into cutting trees because the neighbour complained that the trees were causing problems (such as shading their crops).

People who have not planted trees are often renting or borrowing land. Because the land is not their own they feel no reason to improve it by planting trees. By the time the trees might be ready for harvest the tenants would probably be gone. A special category of tenants who also have little

opportunity to plant trees is the rice growers at the Mwea scheme. Except for a house plot (much like the landless), most have no other land than rice paddy. People have planted Croton megalocarpus trees, a few grevillea, and Euphorbia tirucalli as a hedge, but these plots are very small and the possibilities extremely limited. As stated earlier in this paper, the Mwea-Tebere irrigation scheme tenants suffer one of the most serious fuel scarcity problems in Kirinyaga.

In spite of the many obstacles to tree planting, people throughout the district persist in their afforestation efforts. While there has been some success, much work and effort is still required. Although some families now say that the fuelwood problem has improved, most families feel that the firewood situation is more difficult today than it was in the past.

CONCLUSION

Throughout this paper the problems of firewood shortages and tree planting have been discussed. An obvious policy recommendation is for the government to intensify its efforts by expanding the number and capacity of tree nurseries, encourage more people to plant trees, and to try and stabilize the supply of non-wood fuels, particularly paraffin. But tree planting cannot solve all the energy problems of rural Kirinyaga. Some of the solutions must be more basic: alternative (i.e. non-farm) employment opportunities must be created for the landless and the children of those with land. Without a broadly based and integrated approach to rural energy and other development problems current efforts at tree planting will fall short of their mark.

Table 1. Population in Kirinyaga, 1979

<u>Administrative Area</u>	<u>Population</u>	<u>Population Density</u> ⁺
<u>Mwea Division</u>	81,054	139
Mutithi Location	22,172	118
Murinduko Location	20,603	94
Tebere Location	38,279	217
<u>Ndia Division</u>	120,384	358
Mwerua Location	24,242	294
Inoi Location	36,829	494
Kiine Location	31,820	277
Mutira Location	27,493	428
<u>Gichugu Division</u>	39,993	420
Baragwi Location	30,410	446
Kabare Location	27,862	475
Ngariama Location	31,721	363
<u>Kirinyaga District</u>	<u>291,431</u>	<u>202</u>

Source: 1979 Census of Kenya ⁺Per sq. kilometer

Table 2. Average Landholding Size by Division and Location in Kirinyaga District

<u>Administrative Area</u>	<u>Average Size Per Holding</u>
<u>Mwea Division</u>	3.99 ha.
Mutithi Location	2.58 "
Murinduko Location	4.95 "
Tebere Location	4.44 "
<u>Ndia Division</u>	2.00 "
Mwerua Location	2.22 "
Inoi Location	1.82 "
Kiine Location	2.21 "
Mutira Location	1.77 "
<u>Gichugu Division</u>	2.49 "
Baragwi Location	2.47 "
Kabare Location	2.21 "
Ngariama Location	2.80 "
<u>Kirinyaga District</u>	<u>2.60 "</u>

Source: Kirinyaga District Development Plan, 1979-83.
January 1980.

Table 3. Land Distribution among Sampled Households in Kirinyaga

A. Number of Acres at the Shamba where the Interview Occurred. B. Total Number of Acres Owned or Rented by the Interviewed Household.

Acres	No. Households	%	Acres	No. Households	%
0	49	9.2	0	34	6.4
1	5	0.9	1	13	2.4
2	7	1.3	2	7	1.3
3	31	5.8	3	23	4.3
4	72	13.5	4	62	11.6
5	68	12.7	5	64	12.0
6	70	13.1	6	64	12.0
7	48	9.0	7	46	8.6
8	45	8.4	8	41	7.7
9	31	5.8	9	33	6.2
10	46	8.6	10	46	8.6
11	8	1.5	11	17	3.2
12	17	3.2	12	27	5.0
13	1	0.2	13	2	0.4
14	4	0.7	14	6	1.1
15	23	4.3	15	17	3.2
16	3	0.6	16	4	0.7
17	3	0.6	17	2	0.4
18	0	0.0	18	4	0.7
19	0	0.0	19	1	0.2
20	2	0.4	20	1	0.2
21	0	0.0	21	2	0.4
22	0	0.0	22	1	0.2
23	0	0.0	23	1	0.2
24	0	0.0	24	3	0.6
25	1	0.2	25	3	0.6
			26	0	0.0
N=	534	100.0	27	3	0.6
			28	1	0.2
			29	0	0.0
			30	2	0.4
			31	1	0.2
		
			39	1	0.2
		
			47	1	0.2
		
			70	1	0.2
			N=	534	100.0

Table 4. Inoi Farmers Cooperative Society, Ritui Coffee Factory,
1981/2, Gross Payout to Members

<u>Amount of Shillings</u>	<u>No. of Members</u>	<u>%</u>
1-499	49	6.1
500-999	43	5.3
1000-1499	67	8.3
1500-1999	47	5.8
2000-2999	101	12.6
3000-3999	104	12.9
4000-4999	79	9.8
5000-5999	56	7.0
6000-6999	47	5.8
7000-7999	34	4.2
8000-8999	29	3.6
9000-9999	25	3.1
10000-10999	16	2.0
11000-11999	19	2.4
12000-12999	15	1.9
13000-13999	12	1.5
14000-14999	8	1.0
15000-15999	15	1.9
16000-16999	6	0.7
17000-17999	5	0.6
18000-18999	4	0.5
19000-19999	5	0.6
20000-20999	3	0.4
21000-21999	1	0.1
22000-22999	1	0.1
23000-23999	1	0.1
24000-24999	2	0.2
25000-25999	0	0.0
26000-26999	2	0.2
27000-27999	1	0.1
28000-28999	1	0.1
29000-29999	1	0.1
30000-34999	3	0.4
35000-39999	1	0.1
40000-49999	0	0.0
50000-59999	0	0.0
60000-69999	0	0.0
70000-79999	1	0.1
<u>Total</u>	<u>804</u>	<u>100.0</u>

Source: Compiled and tabulated from Inoi Farmers Cooperative Society payout ledger.

Table 5. The Most Commonly Mentioned Trees, Plants, and Crop Residues Used for Fuel in Kirinyaga

<u>Type of Tree, etc.</u>	<u>No. Households</u>	<u>%</u>
Maize cobs/stalks	407	76
Lantana candid (mucimoro)	370	69
Grevillea robusta (Mubariti, mukema)	315	59
Coffee Prunings	286	53
Eucalyptus (mubau, munyua mai, gum)	255	48
Croton megalocarpus (mukinduri)	195	36
Croton macrostachyus (mutundu)	147	27
Cordia africana (muringa)	146	27
Euphorbia tirucalli (kariaria)	136	25
Bridelia micrantha (mukoigo)	136	25
Strychos spinosa (mubage)	108	20
Cypress (muthithinda)	93	17
Acacia mearnsii (black wattle, muthanduko)	90	17
Pigeon pea (mucugu)	80	15
Combretum molle (murama)	48	9
Jacaranda acutifolia	32	6
Tea prunings	32	6
Pine (mubinduki)	27	5
Sunflower stalk	27	5
	N= 536	

Table 6. Preference versus Actual Use on the Day of Interview

<u>Type of Tree</u>	<u>No. Preferred</u>	<u>No. Actual Use</u>
Grevillea robusta	191	65
Wattle	99	36
Eucalyptus	85	52
Croton megalocarpus	79	33
Bridelia micrantha	34	22
Markhamia hildebrandtii	34	26
Combretum molle	30	11
Cordia africana	26	21
Lantana	13	77
Azanza garckeana	12	3
Piliostigma thonningi	12	2
Croton macrostachyus	12	18
Maize cobs/stalks	7	94
Combretum zeyheri	6	2
"Mutithi" (combretum spp)	6	0
<u>Other Noteworthy Contrasts</u>		
Pigeon Pea	3	20
Euphorbia tirucalli	4	25
Coffee Prunings	3	16
Cotton Plant	0	5
	N= 517	N= 525

Table 7. The Most Commonly Planted Trees

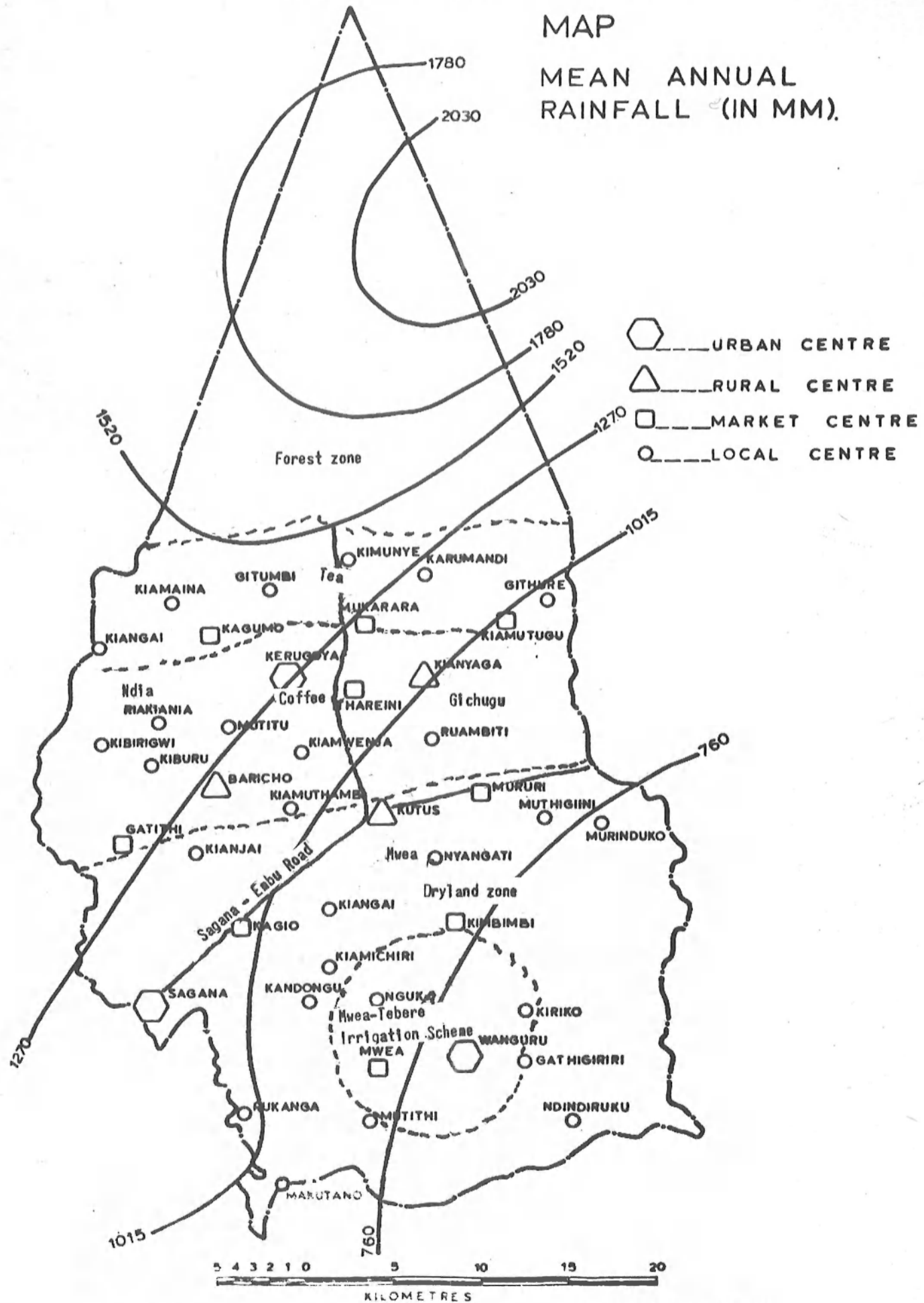
<u>Tree</u>	<u>No. Households</u>
Grevillea robusta	285
Eucalyptus	218
Croton megalocarpus	174
Cypress	82
Wattle	57
Cordia africana	48
Jacaranda	27
Croton macrostachyus	26
Bridelia micrantha	24
Cassia spectabilis	21
Pine	19
Markhamia hildebrandtii	15

N= 340

KIRINYAGA DISTRICT

MAP

MEAN ANNUAL RAINFALL (IN MM).



A. Castro

Source of Map: Kirinyaga District Development Plan, 1979-83.