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Fuelwood Stumpage: Considerations for Developing Country Energy Planning

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FUELWOOD STUMPAGE: CONSIDERATIONS FOR DEVELOPING COUNTRY ENERGY PLANNING

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ABSTRACT

In many developing countries households rely heavily on woodfuels (firewood and charcoal) as their main source of energy for cooking and heating. Though the internal trade in woodfuels is often sizeable, few governments are aware of its importance, and few recoup more than a small fraction of the value of the wood raw material grown on public lands. By charging an adequate fee fór these wood resources, the authors argue, woddfuels production and consumption may be made more efficient. In addition, governments would be better able to finance the investments in their forest sector that are needed to maintain a regular fuelwood supply. The paper outlines the methods energy planners can use to estimate fuelwood values, and discusses a number of problems related to the assessment and collection of fuelwood stumpage fees.

INTRODUCTION

Fuelwood is a major source of energy for households in many developing countries. It accounts for a significant portion of national energy consumption, and is most generally supplied in the form of firewood or charcoal. In low-income Africa, up to 90 percent of households use fuelwood. There is an active trade in wood products, and thousands of people are involved in processing, distribution and marketing. Yet few governments collect more than small fraction of the total traded value of wood products.

This paper discusses the economic justification for charging for wood resources and the effects of considering wood on the stump as a "free good". It reviews a number of methods that can be used for estimating stumpage value, 1/ and the advantages and disadvantages associated with each. It examines a model fuelwood pricing system and briefly explores other types of forest revenue systems. Finally, examples are provided of fuelwood stumpage practices in use in developing countries today.

The discussion of fuelwood pricing should be useful for both forestry economists, who must identify the best ways to manage their nation's wood resources, and to household energy planners, who use data on fuelwood prices when comparing the costs and benefits of use of fuelwood with use of alternative fuels, the relative costs and benefits of improved and unimproved charcoal stoves, etc.

Many of the examples used in this paper are taken from studies made by World Bank household energy economists in Africa. The examples are intended as illustrations only. The paper goes only briefly into the derivation of stumpage values using actual field data. This is done deliberately, as very little data exists that has been collected over a sufficient period of time using rigorous scientific methods. The Household Energy Unit is planning extensive research in the areas of fuelwood pricing, and will publish its findings in future papers.

Definition of Terms

The terms "stumpage fee," "stumpage value," "royalty" and even "stumpage tax" are often used interchangeably in natural resource and forestry economics, both in the literature and in the field. The substitution of one term for the other often causes confusion. In the interest of clarity, the terms, as they are used in this paper, are defined below:

- **Stumpage fee** is the **financial concept** of the value of standing wood resources. It is the compensation the owner of the wood

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1/ Stumpage is defined as "the value of a standing tree".

receives in exchange for surrendering ownership and the rights of harvest. Although the stumpage fee is market-determined, it may be implied rather than stated, and may be paid in-kind or by barter instead of in cash. (When arriving at stumpage fees, this paper looks at the value of wood as a raw material, particularly as a fuel, and not at the value of the forest as a whole as a source of shelter, food, grazing, scenic beauty, etc. The term stumpage fee will be used when talking about the sale of wood from the standing tree).

- **Stumpage value** is the **economic concept** of the worth to society of a unit of wood resource, estimated using the economic concepts of real resource (opportunity) costs and shadow (efficiency) prices. While estimates of stumpage value may be based on observed transactions or may be mathematically equal to stumpage fees, they are not dictated by the market.

- **Stumpage royalty** ("royalty") has a historic meaning of a sum of money due to a country's ruler (the royal person or sovereign) for the use of forest resources belonging to the Crown. Fees were paid for the use of the forest resources, such as firewood, wood for construction, or land for grazing. Later, natural forests were managed, trees planted as a crop, and a stumpage fee charged when the trees were sold. Present-day use of the term "royalty" refers to payments extracted by a public authority (the "Government") in exchange for use of a tree on public land. Usually the term is reserved for products taken from unmanaged natural woodlands or forests, whereas a stumpage fee is collected from the sale of trees from managed forests, whether managed by governments or by private individuals. This distinction adds little to clarity and will not be made in this paper.

Other fees or taxes may be charged in connection with the cutting of wood, such as an entry fee, a cutting permit, an extraction or removal fee, and a product tax. These fees or taxes are all connected with the exploitation of raw material and will be explained when they are mentioned in the text.

Stumpage Fees and Taxes

It is important to point out that a stumpage fee (whether it is called a fee or a royalty) is not a tax, even though some forest services may call it a stumpage tax. The stumpage fee is the reward to the owner of the (tree) resource or the compensation for the use of the resource. A comparison can be made with payment for maize to a farmer or payment for oil to the owner of the oil. Maize farmers expect to be compensated, in the form of an acceptable maize price, for their crop. If a maize product tax was substituted for a maize product price, no private farmer would be willing to grow maize. Owners of oil also expect to be compensated when oil is removed from the well. Just because oil and other natural resources such as coal, trees, minerals, etc., have little or no production costs, they should not be considered as free goods.

I. ECONOMICS OF FUELWOOD FEE SYSTEMS

1.1 The collection of a stumpage fee from the resource user is difficult. Trees are not a concentrated resource. Even if they grow in a dense forest area, there are millions of production units, each with a different value, depending on species, size, the part of the tree (trunk, branches, twigs), etc. This is why many forest services, and a few private owners as well, traditionally have allowed individuals to collect fuelwood without charge provided it is for their own use.

1.2 Today the areas of completely natural forests or woodlands are rapidly disappearing and government forest services and private individuals are spending money on the growing and management of the wood resource. When wood resources are not managed, they tend to be treated as depletable. As a consequence, many areas that were once covered with forests have been denuded as individuals removed the wood without thought of replacing it. If trees are to a renewable resource, available for future generations as well as for the present one, then investments have to be made in replanting and managing the forest areas.

1.3 As populations have increased in size and large numbers of people have moved to the cities, becoming part of the monetary economy, woodfuels have increasingly become an internally traded commodity. Residents of many Third World cities now regularly purchase their woodfuel supply. Like electricity or gas consumers in the industrial world's households, few woodfuel end-users take time to think how many people--landowner, harvester, marketer, transporter, distributor, wholesaler, retailer--are involved in bringing their woodfuel to them. Very few know or care where the wood comes from, for example from privately owned ("freehold") land or traditional tribal land, but few would dispute the proposition that the owner of these wood resources should receive a fair share or "cut" of the final retail price.

1.4 Yet many developing country governments charge only a small fee or even no fee at all for wood from unmanaged government or communal land, especially if it is for household use. So, many people assume that wood for fuel from these lands should be free. However, any raw material or service, if it is of use, has a value. In theory, consumers should be willing to pay for its use. Whether it is practical to charge for it depends on a number of things such as the cost of the material, the expense of collecting payment, the cost, availability and acceptability of substitute products, the value of the end product and the acceptability of the charge to the prospective consumer.

1.5 Farmers who want to clear land for agriculture may consider trees a nuisance rather than a resource, and wonder why they should pay for something that is a liability to them. However, in nearly all cases the woody biomass does have a value: it could be turned into poles, fuelwood or charcoal. The cost of clearing the land could be more than recovered from sale of these products. Even if the wood is burnt on site it still is providing nutrients to the soil that will increase soil fertility for the first year. In such cases, a charge should be imposed to make sure that the wood resource is not wasted. However, the person who clears the land will need information about markets and prices for forest products. Often, wood resources are wasted because of a lack of market intelligence.

Economic Justification for Stumpage Fees

Problems of Open Access

1.6 What is the basic economic argument for charging fees for wood taken from public lands? The economic justification for a public authority to charge for resources lies in the so-called "Tragedy of the Commons" which G. Hardin dramatically depicted in an article published in the magazine Science in 1968. 2/ Hardin attributed the inefficient and wasteful management of many natural resource systems such as international fisheries or medieval European forests to a lack of clearly divided, assignable interests in the resource. According to the standard "common property resource" paradigm, without ownership there are no incentives for husbanding the resource. Attitudes of users to these systems can be summed up in such phrases as, "Everybody's property is nobody's property"; "get it before it's gone"; "why should I save it, if my neighbors will just use it up?" These phrases evoke the individual user's feeling of helplessness as no one individual can manage the resource rationally without the cooperation of all the others. In this situation, there is a tendency for each individual to overuse the resource, to use it up too fast, or even destroy a normally self-renewing system.

1.7 While the term "common property resource" is traditional in economics, the legal profession has long recognized finer distinctions in the management structure of resource systems. Common property (**res communes**) as developed in English common law (it exists also in ancient Roman and German law) refers to a distribution of property rights in a resource system where a well-defined set of users enjoy a well-defined (but not necessarily equal) right to use the resource, while all potential users not belonging to that set are excluded. Ciriacy-Wantrup and Bishop (1975) document that under such systems of property rights, many natural resource systems have been well managed on a sustainable basis for hundreds of years. Examples include the hunting resources of various tribal peoples, the English and Welsh commons, the Alpine meadows of Switzerland, and the areas of Somalia and Kenya where frankincense and myrrh are collected.

1.8 Legal terminology also recognizes a second common property resource management institution, the **res nullius** or "unowned resources"

2/ G. Hardin, "The Tragedy of the Commons," Science, vol. 162, 1968, pp. 1243-1248.

system. Resource economists, recognizing its significance for resource management policy, have termed this subset "open access" common property resources. Examples of both common property regimes may be readily found in the forest and woodland resources of many developing countries. The further identification and study of such systems in Third World contexts is a rich field for research.

1.9 Regardless of the terminology employed, two conditions characterize the "common property resource problem":

(a) Unrestricted access to the resource system by all those who care to use it; and

(b) Some type of adverse interaction among the users of the system.

If free access can be denied, then appropriate management of the resource can be exercised by the party denying access. If there is no adverse interaction among users, there is no reason to deny access. In either case there would be no resources management problem. The ensuing discussions will focus on open access fuelwood resources.

Market Failure

1.10 Resource economists argue that the free access nature of many fuelwood resources contributes to the problem of assuring a sustainable supply of woodfuels. In economic terms, what happens is called "market failure." This is not a comment on the presence or absence of markets for goods and services. In cases of market failure, markets are not doing their job of assuring efficient production and consumption of goods and services. Two kinds of market failure apply in the case of fuelwood resources:

(a) Non-recognition of user costs; and

(b) Effects on other sectors (externalities) of woodfuel consumption

1.11 Non Recognition of User Costs. Participants in a modern market economy follow a basic rule regulating their consumption: Their willingness to part with their wage earnings in exchange for goods (and services) is directly proportional to the additional benefits they expect to receive from obtaining those goods and services. Consumers buy a given good until the marginal benefit received from the last unit purchased in just equal to the marginal cost of acquiring it in terms of money foregone. Further purchases of that good would waste income that could be applied to buy quantities of other desired goods providing higher incremental benefit. Reverse reasoning explains why purchasing less of that good would also be suboptimal. By following the marginal benefit equals marginal cost rule, consumers (quite unconsciously) maximize the total benefit received from spending the fruits of their labor.

1.12 A villager, a woodcutter or a charcoal maker respond to similar economic signals guiding their production and consumption decisions. In the case of the decision to cut a tree, the choice can be modeled as follows. On the marginal benefit s de, the wood harvester obtains a certain unit value of fuel for cooking, firewood for cash sale, or feedstock for charcoal making. But what marginal costs does the wood harvester face? We consider two cases: (a) The "private" case where the cutter owns the tree because he owns the land under it or has purchased harvest rights; and (b) The "open access" case in which entry to the woodland or forest is free to all.

1.13 The exploiter of a private stock of wood faces two costs. First is the marginal extraction cost, i.e., felling the tree, cross-cutting and splitting, hauling, and stacking. This is usually expressed as a marginal opportunity cost of the harvester's labor which could have been applied to other productive activities.

1.14 The second is termed the marginal user cost (also called "scarcity rent") and represents the cost of consuming a tree today instead of in the future. This user cost may be subdivided into two distinct components: The loss of future wood resources, and the loss of growing stock

(a) The loss of future resources applies to both exhaustible (e.g., oil) and renewable (e.g., tree) resources. One can think of a stock of standing trees as money in the bank. The value of a bank deposit increases over time ("interest") as a "reward" for deferring consumption; the value of a fixed stock of standing trees or of oil in the ground also increases over time at a rate determined by the strength of preferences for present vs. future consumption. If this opportunity cost did not exist, there would be strong incentives to cut and sell every tree in order to invest the sales receipts in the bank. 3/

(b) The loss of growing stock applies only to renewable resources and represents the loss of increases in resource stocks due to biological growth. Thus, assuming the tree has not yet reached the mature phase of its life, a decision to harvest today sacrifices future gains due to growth.

Depending on how a country's wood resources are managed in relation to wood demand, the sum of cost components (a) and (b) may increase, decrease or remain constant over time. In the optimal steady state scenario of long-term sustainable forest exploitation, the marginal user

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3/ This is Hotelling's arbitrage opportunity.

cost is constant but positive, reflecting a constant level of wood resource scarcity. 4/

1.15 The marginal costs faced by a harvester of open access wood resources are quite different from the private case above. The marginal extraction costs are still present, whether measured in personal labor costs or in payments to woodcutters. But the user costs are not recognized by an individual exploiter because of insecurity of tenure. As each tree [potentially] belongs to everybody and anybody, there are no guarantees and much uncertainty that a tree left standing today will be left to grow and be available for a particular individual's harvest in the future.

1.16 In addition, each tree removed by, say, a charcoaler makes it more difficult to obtain wood supplies in the future. This is true not just for the one charcoaler (private cost), but for all charcoalers dependent on the wood resource (social cost). Thus, private tree cutting in open access forests affects all woodfuel users in a way which is not factored into the individual charcoaler's wood harvest decisions. And, since private costs are lower than social costs, the rate of wood cutting will be higher than socially desirable.

1.17 This type of adverse interaction between users of freely available but limited resources is known as a "congestion externality." The same analysis applies to why fish in the ocean are over-exploited, or why many uncontrolled-access highways are congested.

1.18 Effects on Other Sectors (intersectoral externalities). This is the second type of market failure. An externality (effect on a third party) exists when third parties are affected in a way that is not taken into account in the transaction between the buyer and the seller. An example of this is pollution. Suppose that a beer brewery is downstream from a fertilizer factory. The factory dumps pollutants into the stream. The brewer, who takes water from the polluted stream, has to purify it before it can be used to make beer. This imposes extra costs on the brewer and raises the price of beer. Yet the farmers who buy the fertilizer pay the same price for it whether the factory pollutes the stream or not. Economists would say that too much fertilizer is being produced, and not enough beer!

4/ The user cost could be negative in an "over-forested" region located a long way from centers of wood consumption. If there are higher value opportunities for use of the land than tree growing, this leads to rationally motivated short-term tree "mining." On the other hand, a country undergoing rapid deforestation, such as Mauritania in the dry Sahel, experiences positive and increasing user costs over time.

1.19 Externalities from fuelwood exploitation are often the result of linkages between sectors of the economy that depend on natural resources. These effects might include:

(a) Loss of agricultural productivity, as a result of increased moisture evaporation and/or soil depletion following uncontrolled fuelwood harvesting;

(b) Loss of hydroelectric supply potential, as a result of soil erosion, loss of watershed capacity and siltation of dams;

(c) Loss of public water supply potential, similar to (b) above;

(d) Loss of other forest products, in which the destruction of woodlands may cause a local scarcity of game, medicinal plants, raw materials such as hardwood or bamboo used to make artisanal products, undergrowth for grazing, and other products and amenities derived from the forest; and

(e) Loss of carbon dioxide fixing ability, which has been observed on a global scale when forests are destroyed and is one cause of the so-called "greenhouse effect."

1.20 These externalities are often evaluated for cost-benefit purposes by placing a value on the foregone benefits. For example, loss of hydroelectric potential could be valued by estimating the loss of productive life span of the hydro dam in years. Multiplying the years by the average annual value of electricity output gives a monetary figure for the loss. Another way to measure externalities is in terms of the preventative costs, or the costs of restoring whatever has been lost. For example, one can approximate the cost of lost topsoil by the cost of the artificial fertilizers needed to restore the lost soil fertility. Whatever estimation technique is used, a negative externality implies that the social cost of fuelwood consumption is greater than the private cost, and that too much wood cutting is going on.

Conclusions From Market Failure

1.21 The main conclusion to be drawn from the above analysis of market failures is that open access fuelwood resources are underpriced or undervalued relative to their worth to society. Some of the effects of this underpricing are discussed in following paragraphs.

1.22 Over Consumption of Fuelwood. An axiom of consumer behavior is that the cheaper a good is priced, the more of it will be consumed. 5/ Note that "overconsumption" in this context means that the marginal social cost of woodfuels consumption, as measured by the concepts of

5/ This axiom does not apply to Giffen goods, of which fuelwood is not observed to be one.

marginal extraction, user and external costs, is greater than the marginal social benefit. 6/ Overconsumption is an economic comment of the efficiency of fuelwood production and consumption, not a value judgement reflecting a desire to keep woodfuel dependent consumers in "energy poverty."

1.23 The overconsumption argument is often challenged on two grounds. The first is that the real price of woodfuels in many countries has stayed relatively constant or even decreased. This finding seems to contradict claims of underpricing, overconsumption and approaching scarcity and suggests that supply and demand may be in long-term balance in spite of population pressures. However, some observers, notably Barnes (unpublished draft), have observed that woodfuel markets tend to maintain constant real prices until the onset of scarcity, when they rise very quickly to a higher price plateau. The reasons for this price behavior are not clear, but we can make an educated guess that:

(a) Initially, the supply of fuelwood is elastic as land is cleared for agriculture and/or woodcutters chop into the standing stock of "fuelwood" trees. As wood capital becomes depleted, the supply becomes more inelastic and real prices rise.

(b) The price of backstop fuels (principally kerosene), consumer transition to lower quality but less expensive fuels (e.g., twigs, agricultural residues, dung), and the long run supply response from plantations and distant (formerly sub-marginal) natural forest stands all work to put a cap on price rises.

(c) Imperfect flow of information in woodfuel markets may also contribute to the abruptness of the price transition.

1.24 The second challenge to the overconsumption argument is that woodfuels pricing has little effect on quantities demanded because woodfuels demand is inelastic, particularly in the poorest countries where few alternatives to woodfuels are available in the short run because of poor distribution of modern fuels. This criticism does serve to point out some of the limitations of pricing policy, but it overlooks the following points:

(a) There is often a considerable difference in long run vs. short run energy demand elasticities, with consumers making adjustments over long time periods that cannot be detected through short-term observation. Long lead times are characteristic of the woodfuels sector, with both fuelwood shortages and supply enhancement measures (e.g., tree planting) occurring over long periods. Furthermore, underpricing of wood resources is a disincentive to infrastructure investments required to sustain long term transitions to modern fuels.

6/ Irrespective of market failure, in some fuelwood markets the retail price may nevertheless reflect full economic costs due to middlemen capturing high economic rents. See paragraph 1.28.

(b) While household demand for cooking services may be inelastic, successful stove projects demonstrate that the demand for woodfuels may be made more elastic. Carefully designed cooking efficiency programs, especially for urban areas where consumers are dependent on charcoal, could help consumers lower cooking costs and thus partly offset the impacts of realistic fuelwood pricing policies. And also, these same pricing policies provide consumers incentives to adopt fuel-saving stoves.

1.25 Wastage and Inefficient Transformation. Where fuelwood is converted to charcoal for transport to distant urban markets, underpricing of wood resources encourages inefficient charcoaling practices and wasting of wood. Paying only a fraction of the true cost of his input, the charcoaler has little or no incentive to economize on the use of wood. Similarly, the underpricing of wood from open access forestlands limits the incentives for adoption of improved wood harvesting practices and charcoal kilns in those areas.

1.26 An example from the trial introduction of improved charcoal kilns in Jamaica illustrates the incentive effect economic wood pricing could have. The selected improved kiln type, the Casamance modified earth mound, has a chimney made from three used oil drums. Estimated cost for the chimney is about US$30 (Jamaican $160). This is a significant investment for traditional charcoalers. Demonstrations involving 30 local charcoalers confirmed that the financial rate of return the producer expects to make governs his willingness to make the initial capital investment. Table 1.1 shows the financial incentives to the charcoaler of using the Casamance rather than the traditional kiln. The incentives were estimated by calculating the producer's margin, or producer price less charcoal production costs, at varying wood prices.

Table 1.1: CHARCOAL PRODUCERS' MARGIN: JAMAICA
(J$/Tonne)

Wood Cost	Kiln Type: Traditional	Kiln Type: Casamance
0	139	205
5	105	180
10	72	155
25	-28	80
50	-195	-45

Source: "Jamaica Charcoal Production Project," UNDP/World Bank report 090/88, September, 1988.

1.27 The table shows that if the producer is paying nothing for wood input, the level of "profit" per tonne is close to 50 percent higher with the use of the Casamance kiln. However, if wood costs just J$10 per tonne (less than US$2 per tonne) then the improved kiln yields more than double the profit of the traditional method.

1.28 Transfer of Rents to Urban Consumers and Middlemen. In many developing countries, urban fuelwood and charcoal demand accounts for 30-50 percent of all woodfuel demand. As many formerly wooded areas are not replanted or managed to ensure regeneration of trees, a net transfer of resources from the country to the city takes place. This increases poverty in rural areas and eventually leads to urban migration, resulting in even greater urban woodfuel demand. Thus the economic rent from tree production is transferred from rural dwellers, or the government, to urban consumers. If the woodfuel marketing and transport sector is not organized competitively these rents may be effectively captured by middlemen.

1.29 Disincentive for Tree Planting. Wood derived from open access lands often competes in the market with wood from private plantations. The price (stumpage fee) the plantation owner can receive for his wood is the production cost of the "last" tree sold on the market. If the cost of this marginal tree only includes extraction and transport costs, it will significantly depress market prices and make tree growing less financially viable. Even if tree growing is for subsistence consumption and not income generation, individual initiative will be thwarted when trees from open access areas are available at low cost.

1.30 Drain on Government Revenues. The underpricing of wood resources also results in a hidden but real drain on scarce public resources. In addition to the lost opportunity to raise revenues through stumpage fees, governments may have to spend heavily to subsidize afforestation or reforestation in order to stabilize the soil or relieve local shortages of fuelwood. Costs for electric power generation and public water supply may also increase if enough wood has been cut to lead to damage to these other sectors (see the discussion on externalities, paras. 1.18 to 1.20).

Benefits of Charging for Fuelwood Resources

1.31 Several benefits can be obtained by charging for fuelwood resources. Those most commonly mentioned are:

(a) To ensure that the resource is used with care;

(b) To bring in revenue so that government can finance investment and services, including the forest service;

(c) To encourage investment in tree planting and management by all sectors of the community;

(d) To ensure that trees will remain a renewable resource rather than a minable deposit;

(e) To encourage (rural) employment; and

(f) To save foreign exchange.

Of course stumpage fees cannot be raised so high that the wood products are priced out of the market. However, if adequate market intelligence is available, a proper assessment of the commercial value of the available wood resources can be made. Some trees or parts of trees may have a higher value when sold as poles, sawlogs, peeler logs etc. rather than fuel although the latter is usually the dominant end use. Therefore, market intelligence will give a good idea of the amount of effort that can be put into the management of wood resource.

Cost of Charging for Fuelwood Resources

Costs to Consumers

1.32 Since woodfuel use is concentrated in the lower income levels of developing country societies, it is important to evaluate the effects that stumpage fees would have on consumers. When estimating the cost to consumers, the following factors have to be considered:

(a) The relative proportions of fuelwood supply obtained from open access, managed access and private lands;

(b) The form in which the woodfuel is consumed (i.e., as firewood or charcoal);

(c) The distance from the consumer to the woodfuel source(s);

(d) The structure and competitiveness of woodfuels transport and marketing; and

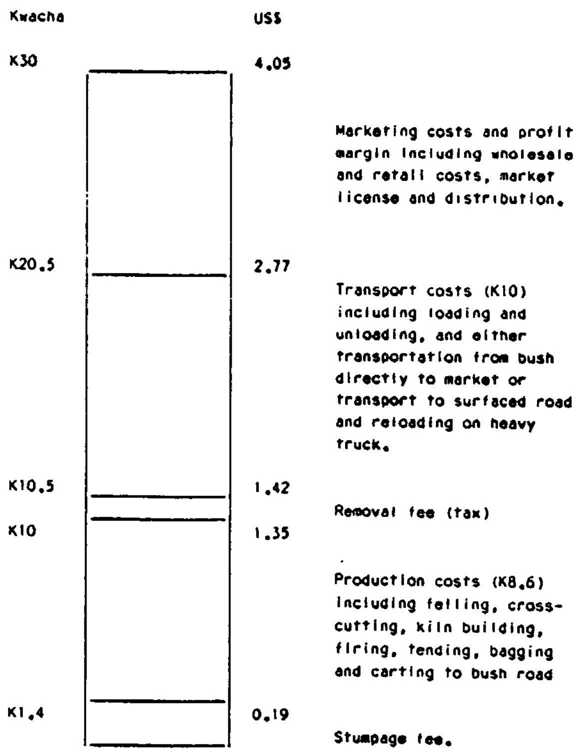
(e) The elasticities of woodfuels supply and demand.

1.33 Not all the fee burden will be passed directly to the consumers. A portion of it will be borne by the woodfuel producers, transporters, and dealers. A charge for the raw material may provide an incentive to increase efficiency, or it may cut into profits as middlemen reduce their mark-ups.

1.34 Studies of charcoal sales in Sub-Saharan Africa have shown that the roadside price of charcoal in the areas of production is typically one-third the final retail price of charcoal to urban end users (see Figure 1.1). Therefore, the percentage effects of stumpage fees on consumer prices are diluted by at least this 3:1 ratio. However, as is shown in Figure 1.1, the actual stumpage fee in Zambia is only about five percent of the selling price. To keep pace with inflation the stumpage fee should be about three times what it is, but even a tripling of stumpage will only cause an 8.5 percent increase in the selling price, other things being equal. A similar increase in the stumpage price of firewood would increase the market price by about four percent.

FIGURE 1.1

COST COMPONENTS OF A 40 kg BAG OF CHARCOAL IN LUSAKA, ZAMBIA (OCTOBER 1988)



Costs of Fee Collection

1.35 One comment frequently made is that existing stumpage prices for woodfuels are so low that forest services cannot cover the costs of hiring forest guards and other field personnel. But it is often truer to say that revenues are low because a large proportion of stumpage fees is never collected, or at least never turned over to the government. In many forest services, the guards and other forest personnel receive such low pay that they cannot live decently on their wages. Thus there is a great temptation for the collectors to pocket a percentage of the fees, or to take handouts from the charcoal producers for not collecting the fees at all. Forest workers may also start cutting down trees themselves and selling products such as poles or charcoal as a way to increase their income.

1.36 In countries where stumpage fees are charged, it has been found that only a fraction of the fees is collected and turned over to the government. In Sudan, for example, less than 10 percent of existing stumpage fees are handed over. What percentage is actually collected is not known.

1.37 Some practical measures need to be taken to improve the collection of fees. First, forest personnel should be better trained and better paid. Record keeping should be improved, and there should be more supervision (at least on a monthly basis) of fee payments. There should be improved recording of the quantities of woodfuels entering major trading centers. More trained field personnel, with adequate means of transport, should be employed to handle fee collection and recording. Experience gained so far suggests that the extra money spent on these measures would pay for itself many times over.

1.38 Another weakness in present systems is that most forest services have no control over the revenues collected. These have to be turned over to the government, which often treats them as general revenue. The money is seldom used to improve the forest service. Therefore, the forest service has little incentive to increase fees or improve the rate of collection. If forest services were required to be self-financing, and were given control over their revenues from stumpage fees, they would have more incentive to collect the fees. One strong incentive for fee collection would be to give a small percentage of collected revenues back to the collectors themselves, as a commission.

1.39 An example from Sudan shows how much revenue can be lost when records are poorly kept and stumpage fees are not turned over. In Northern Sudan in 1987 an estimated 14.4 million m^3 of roundwood, equivalent to 18.0 million m^3 of standing wood, was used to make about 60 million (40 kg) bags of charcoal. If the current stumpage fee of US¢11 per standing m^3 (US¢14 per usable m^3) had been collected and handed over to government, this would have amounted to US$2.0 million. In fact, the total revenue from all forest products was about US$0.08 million. So, almost 96 percent of the revenue the government should have received from its fuelwood stumpage fees was not collected. This represents a substantial loss of income to the government. It is not surprising that, under these conditions, governments cannot afford to pay for better forest services.

Types of Stumpage Fees

1.40 Basically there are two kinds of stumpage fees: The flat rate fee that varies according to end use, diameter/length and species but does not consider distance to the market, and the variable fee which takes all or most variables into consideration. Forest services apply both kinds of stumpage charges but the flat rate is the most common simply because most of the areas under services jurisdiction are unmanaged.

1.41 Assessing the value of a tree is not easy. Trees may have an intrinsic value in themselves, but generally speaking they have a derived value, derived from the variety of products they can be turned into. The principal <u>uses</u> of wood in order of importance are fuel (firewood and charcoal), poles, sawnwood, paper products, panel products and regenerated cellulose (rayon). When we look at the <u>value</u> of wood, the order of importance is reversed. In terms of the value of the raw material (not considering the value of the finished product, such as paper or rayon), peeler logs are the most valuable, followed by sawlogs, pulpwood, poles, logs for reconstituted wood (excluding plywood), and fuelwood for firewood and charcoal. Logs can also be differentiated according to the wood species (mahogany, oak, eucalyptus, etc.) and according to the diameter or length of the log, etc.

1.42 So, trees will be sold for different prices depending on their size, species and end use. Also, parts of the same tree can be sold for different prices, and possibly to different markets. For example, the first or butt log might be sold as a peeler log, the second and third logs for sawnwood, the fourth log for pulp, the top and branches for poles and fuel and the sawmill off-cuts, bark and sawdust for particle board and/or fuel. The roots may even be used for fuel and the leaves for fodder.

1.43 Bearing in mind what has been said, forest services usually levy a flat rate royalty for different wood products from unmanaged natural woodlands and forests. Thus wood for fuel has the lowest stumpage charge, followed by poles, sawlogs and peeler logs.

1.44 The variable stumpage fee rate is more likely to be used for wood from managed public areas. This is because wood is generally sold by tender or auction, or factories may offer fixed prices for the delivered wood. Thus the distance to the factory or market can play an important role in determining the stumpage price. The market price for the end products also plays a critical role in determining the price offered for the standing wood.

Optimal Fuelwood Stumpage Fee

1.45 Figure 1.2 shows the conceptual derivation of an optimal fuelwood fee in a given situation. The supply curve labeled $AC_{private}$ is the average cost of wood removal, and represents the cost experienced by individual wood resource exploiters. It is assumed that the cost of the wood raw material is excluded from these costs. If there is free entry into the production process then the equilibrium fuelwood price will be at the point where the marginal cost curve (private) cuts the average cost curve (private) and by inference where the demand curve cuts these two curves. In Figure 1.2 this point gives a price of P_{pr} per unit of fuelwood production when the demand is for Q_{pr} units.

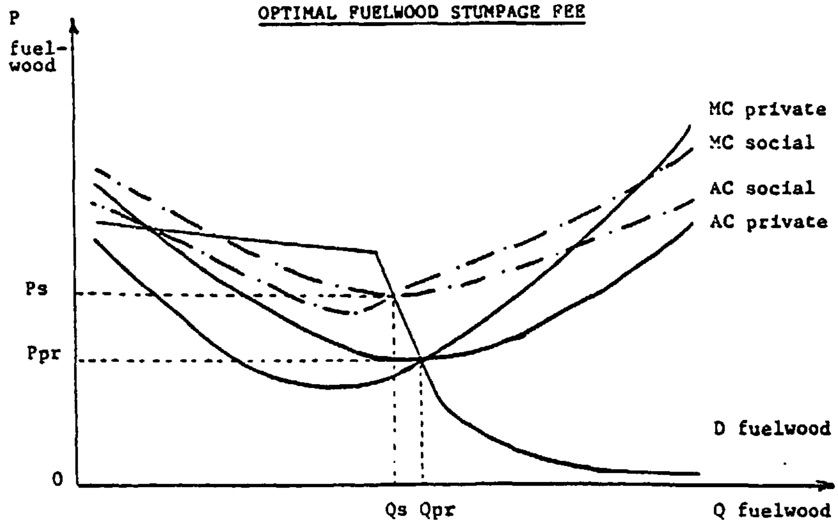
1.46 The supply curve AC_{social} is the average cost of wood production including the value of the wood raw material equivalent to its replacement cost. Again free entry to production is assumed so the total demand will be Q_s. The demand curve for fuelwood is shown to be kinked, indicating that over a certain price range there are very few substitutes for fuelwood. If the price increased above this "inelastic" range, then people would switch to using such fuels as crop residues or kerosene.

1.47 The difference in price between the two equilibrium points represents the stumpage fee to be charged in order to ensure a continuous supply of this renewable resource. The lower supply curve ($AC_{private}$) may contain some stumpage fee element in its make up but this fee is insufficient to cover replacement costs.

1.48 Figure 1.2 represents the cost structure at a specific distance from the market. It also assumes one end product only, a specific discount rate and by inference one way of raising the trees. These are very restrictive assumptions. It is extremely difficult to derive such cost curves in practice. Rather there may be a series of cost and demand curves depending on the various methods of growing trees and the markets for the products. The markets may change over time. For instance, trees planted for pulp wood ten years ago may be diverted to fuels and poles because these products now project a better price. Therefore, in practice, the level of fuelwood stumpage is calculated by the techniques described in Section II.

FIGURE 1.2

OPTIMAL FUELWOOD STUMPAGE FEE



Legend
P = Price
Q = Quantity
AC = Average Cost
MC = Marginal Costs
S = Social
pr = Private

Other Forest Revenue Systems

1.49 The stumpage fee (or royalty) is the basic charge for the wood resource. It can be charged for wood from either public or private land. But governments in general and forest services in particular often impose other fees and/or taxes on wood. These can be in addition to the stumpage fee, or in place of it. An FAO booklet, "Forest Revenue Systems in Developing Countries: Their Role in Income Generation and Forest Management Strategies" (Grav, 1983), gives a list (p. 79) of the types of forest charges and alternative forest revenue arrangements. For woodfuels, in addition to the stumpage fee, charges can be made for:

(a) Forest products (value added tax);

(b) Productive factors (equipment/labor); and

(c) Services.

Charges on Forest Products

1.50 Charges on forest products are the most common method of raising revenue. In the case of wood products, they are often used as a substitute for stumpage fees, because they are easier to calculate and collect. Strictly speaking, a charge levied on a product is a value added tax, not a fee.

1.51 There are drawbacks to taxing the product instead of charging for the raw material. In the case of charges for charcoal, for example, factors such as efficiency of conversion and the raw material's suitability for use as charcoal may be ignored. Valuable species and/or sawlog-sized material may be used to make the charcoal. Also, two or three times more wood than necessary may be used in the conversion process. Great savings can be realized if the raw material is properly prepared and the charcoaling methods used are efficient.

1.52 If private wood growers are taxed on their wood products, they have no incentive to grow wood for profit, because government is capturing the value of their raw material. One way around this problem is to return a tax credit to the growers to compensate them for the raw material they produce.

1.53 Product taxes can be charged in addition to stumpage fees. In that case, all the tax money can go to the taxing authority, either the local or the central government (or both). This money can be treated as general revenue and be used to finance government services including the forest service. However, from a business viewpoint, the stumpage fee or proxies for it should be credited to the forest service or grower, to enable the wood producers to cover their own costs, including a profit margin.

1.54 <u>Collecting Fees Along Main Trade Routes</u>. When forest products are traded, they are usually transported along major trade routes. Agents for central and local governments regularly collect fees from vehicles carrying forest products along these routes. However, because the government collectors are poorly paid, and little control is exercised, a large portion of the fees is never turned in. In order to improve the remittance rate, a system of bonuses or commissions could be introduced, together with a good monitoring and reporting service on key transport routes to tabulate the trade in forest products.

1.55 A second example from Northern Sudan illustrates the size of government losses. In the northern area, an estimated 60 million 40 kg bags of charcoal are consumed annually. About 25 million of these bags go to urban areas. In 1987 the central government tax on charcoal came to SL 0.15 per bag. 7/ If just the tax from urban charcoal had been collected, the revenue from this source would have been SL 3.75 million. But, in the period 1982-1985, the total revenue from all forest products averaged SL 0.34 million per year. When the figures for 1987 become available, they are expected to be similar. It is worth pointing out in this case that if all tax on charcoal in Sudan was collected and turned over to government, it could finance the 1988 forestry budget about four times over.

<u>Charge on Productive Factors</u>

1.56 Governments sometimes use charges on productive factors as a means of raising revenue, either in addition to or in place of stumpage fees. These charges have mainly been applied to sawmills. Either the rated capacity of the mill is taxed or a tax is imposed according to the size of the workforce. A similar concept could be applied for industrial-scale charcoal production. For example, a charge could be levied based on the capacity of the charcoal kilns. But such a system is a poor substitute for stumpage fees because the rated capacity of a kiln does not give an accurate indication of actual output. It is also impossible to apply such a charge to firewood, making it very selective.

<u>Charges for Services</u>

1.57 Forestry services may collect additional charges besides the stumpage fee to compensate for the work they do in supervising cutting operations. For example, a fee may be charged to pay forestry personnel for estimating the volume of wood to be cut, or to pay for the time they must take to measure the trees and control operations when an area is being harvested. This is sometimes called an entry fee. Entry fees are

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7/ This tax consisted of the original 1932 fee of SL 0.063 per 40 kg sack plus an additional SL 0.087 to account for inflation(!). In addition, there is a local district tax of SL 0.10 per sack. The exchange rate in November 1987 was SL 4.5 = $1.00 (parallel market: SL 6.0 = $1.00).

usually flat rate charges for services. Though they may appear to be similar to stumpage fees if they are directly related to wood volumes, they are rarely, if ever, used in place of stumpage fees.

1.58 In addition to the entry fee, a removal permit may be issued by the forester (for a set fee) when the logs or products are removed. At the same time, the forester may collect a tax on the wood product.

1.59 Although taxes on productive factors and services may be easier to collect than stumpage fees, and are a legitimate means of raising revenue, they should not be used in place of stumpage fees. Applying a product tax instead of a stumpage fee for the actual wood raw material is a second-best solution.

II. METHODS FOR ESTIMATING STUMPAGE VALUES

2.1 Market distortions due to taxes and subsidies, shortage of accurate, time-tested data, and confusion of terminology complicate the task of estimating stumpage values. These problems have to be taken into account when using the methodologies described in this section.

2.2 The main methods used to estimate fuelwood stumpage values are:

(a) Market Approaches:

(i) Residual stumpage;
(ii) Auction sale/tender;

(b) Surrogate market approaches:

(i) Opportunity.cost of gatherer's time;
(ii) Differential land values;

(c) Cost-based approaches:

(i) Alternative fuel substitution;
(ii) Wood replacement cost.

2.3 Stumpage values can be estimated using either financial or economic criteria. The basic methodology is the same for both. For simplicity, this section focuses on financial analysis, using examples of actual costs and prices. Key price adjustments for economic analysis are noted in the text. In application, the level of decomposition for shadow pricing purposes will depend on the level of accuracy desired. Good examples may be found in Gittinger (1982) and other standard texts on project economic analysis.

Market Approaches

Residual Stumpage

2.4 One way to determine the stumpage fee for the various forest products is to work back from their market price through the wholesaler, transporter, producer, extractor, and tree cutter (or feller), allowing for local taxes and fees, rent, and profit margins. This will give a "residual stumpage fee" which sets a limit on what can be charged for the standing tree, taking into consideration how much of the tree is saleable. This analysis has been performed in Table 2.1 for charcoal production in Sudan at a specific distance (400 km) from the market. The table groups the costs under various headings and each line item may summarize many individual operations. For example, charcoal production costs include but are not limited to--tree cutting, preparation of the raw material, kiln building, firing, cooling, charcoal bagging, loading, etc.

Table 2.1: 1986 COST COMPONENTS OF RETAIL CHARCOAL PRICES IN KHARTOUM, SUDAN FOR CHARCOAL PRODUCED IN THE BLUE NILE PROVINCE

Cost Items (Including Profit)	Line Item Cost Per Sack a/ (Unit US $)	Cumulative Per Sack (Unit US $)	Total Per Tonne (Unit US $)
Marketing Cost in Khartoum	0.79	3.50	100.00
Transport and distribution costs (400 km one way)	0.70	2.71	77.50
Charcoal depot costs including transport to depot (50 km bush roads)	0.30	2.01	57.50
Charcoal production costs (including felling)	0.87	1.71	49.00
Residual price for charcoal wood	0.84	0.84	24.00
Residual Stumpage Price			
Cost per tonne of wood used for production b/	4.80		
Cost of wood per m^3 used for production b/	4.00		
Cost per m^3 standing (residual stumpage fee) c/	3.20		

a/ Average weight of sack in Khartoum market assumed to be 35 kg, 80% (28 kg) of which is lump charcoal.

b/ On average five tonnes of air dry wood (15% m.c.d.b.) required to produce one tonne of fully carbonized charcoal sold in the market place. Actual production, accounting for losses, would be 1.2 tonne per five tonne of air dry wood. Also 1.[illegible] m^3 = 1 tonne air dry wood; therefore six cubic meters are used per tonne of charcoal sold.

c/ Assume that 20% of each selected tree is not suitable for charcoal production. Also because not all species, and not all sizes of trees are desirable for charcoal production the actual stumpage price for the average tree irrespective of species or size may be between $2.1 and $3.2 per m^3 standing.

Source: Sudan Forestry Sector Review: Eastern and Southern Africa Region 1986.

2.5 The charcoal production process has been studied in detail in Sudan. There, charcoalers range from casual producers, who generally use inefficient techniques, to large-scale, efficient producers who run well-organized 'bush camps' for four to six months at a time. In the camps, most of the charcoal is first produced in small kilns, using unseasoned wood, in a quick-production process. As the season progresses, the wood raw material is dried properly, larger kilns are built, and the production cycle takes longer. All these steps increase the efficiency of production. Because efficiency improves as the season progresses, data should be collected and production costs averaged over a complete season. The collection of data and estimate of costs may involve large numbers of people, using a variety of estimation techniques. Total costs of the operation, not just direct costs, need to be collected.

2.6 When calculating stumpage values by this method, we have to determine the wastage at each phase of the production and marketing cycle. For example, only certain tree species and specific minimum diameters may be used for charcoal production. Therefore only a small percentage of the total number of trees in a parcel of woodland may be used, and only a portion of the volume of those trees that are selected. While the tops and thin branch wood are usually discarded, the volume of wood used is usually greater than volume of the stem wood alone. If wood is measured by weight, the moisture content should be known, so that the weight can be specified at a standard moisture content.

2.7 When using the residual stumpage method, the volume or weight sold to the consumer has to be related to the standing volume of wood, not the production ex-factory or ex-depot. Therefore, we have to find out how much charcoal is lost through powdering, handling and transportation etc. from the time it leaves the site until it is finally sold at the market. If this is not done, the calculated residual stumpage value may be too high.

2.8 Two factors likely to affect the residual stumpage value are: (a) the market price may be controlled, either by direct government intervention through subsidies on woodfuels or through subsidies or price controls on substitute products; (b) the government may have already charged a stumpage fee and/or a product tax. Working backwards from the selling price, one may end up at or close to the mandated price or tax, especially when charcoal is being brought over long distances.

2.9 Transport costs must be factored in. 8/ As these vary with distance to the market, the residual stumpage price should go down as one moves away from the market. While at the margins the residual stumpage price approaches zero, near to the market it may be high enough to induce people to grow trees commercially for use as fuelwood. As an example, the location of the Ethiopian capital was stabilized when entrepreneurs established a ring of woodlots close to this population center.

2.10 A drawback of the residual stumpage method is that it implies that trees are going to be used for one purpose only. In practice, wood has a multitude of uses. A good entrepreneur will know the markets for fuelwood, charcoal, poles, handicraft products, roughly hewn timber and sawlogs and know what mix to aim for in order to maximize profits. If proper market intelligence is applied the actual stumpage price for a parcel of trees may vary considerably from the single end use residual

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8/ For detailed discussion of transportation costs, see Annex 2.

stumpage price. Therefore, by managing the tree resources, knowing what species and size classes are present and knowing the potential markets for tree products, a much increased revenue could be obtained that might more than cover the additional management costs.

2.11 Economic Analysis. To arrive at an economic stumpage value, standard shadow pricing methods can be applied to the build-up of price from woodland to market. Foreign exchange components in the production, transport and marketing of the woodfuel need to be adjusted to reflect over- or undervaluation of foreign currency (UNIDO method); alternatively, if working in border prices a standard conversion factor should be applied to domestic components (Little-Mirrlees (1974); Squire-Van der Tak (1975)). Actual or imputed wage rates should be shadow valued to reflect the scarcity value of skilled and unskilled labor.

2.12 The resulting estimates of economic stumpage value will account for certain distortions in the domestic economy but will be fundamentally based on market-ascribed values of fuelwood and woodfuel products. While a well-known procedure, residual stumpage valuation essentially begs the question of whether fuelwood should be valued differently by society than by the private market. This question was explored in detail in Section I. It is especially relevant if most of the fuelwood is harvested from unmanaged or uncontrolled access public woodlands. In this case, market woodfuel transactions may reflect a low or zero fuelwood stumpage value, since the wood was obtained by the producers at low or zero private cost. The apparent value of fuelwood at the forest gate often reflects only the cost of felling, cutting and haulage, with no allowance for the value of the wood resource itself.

Auction Sale/Tender

2.13 The residual stumpage method is complicated, and the residual arrived at may already be influenced by taxes or subsidies. If the trees were sold standing, or if the owners marketed the cut wood themselves, the stumpage fee could be arrived at directly. Also it is usually assumed for economic analysis that the resource owner's sale price relects the "sum of sacrifices" (opportunity costs) made in producing the trees. Thus the auction/tender sales price should reflect economic stumpage values more accurately. But the auction/tender method should really only be used when the seller (government or private owner) knows what wood resources are being grown, and has some idea of the potential market for the wood products. Government forest services often do not realize the potential value of the wood growing in government forests and woodlands, and will undervalue the wood to be sold. Many buyers also do not know the potential value of the wood, and may consider some marketable trees or parts of trees as waste (the tops and branches sawmillers leave behind are an example). The owner of the resource should either charge for this "waste" or market it separately. FAO experts pointed out several years ago 9/ that if whole-tree marketing had been practiced in the conifer plantations of Western Kenya, the government could have increased its revenues from the plantations considerably. 10/

2.14 While selling trees standing gives a direct figure for the stumpage price, this figure may also be influenced by fixed prices and subsidies. This is especially so for charcoal, where either the selling price is fixed by government or subsidies are given by not charging a realistic price for the wood raw material, or a combination of the two.

Surrogate Market Approaches

2.15 Market-based methods presuppose that fuelwood is an actively bought and sold commodity. Often in rural areas fuelwood is gathered for personal consumption or acquired through traditional systems of exchange that are hard to measure or understand. Even when fuelwood is marketed, the price obtained may not reflect its true value. Lacking clear market signals for fuelwood, the analyst looks for a substitute or complementary good or service from which fuelwood values can be inferred. Two examples of surrogate market methods are discussed in the following paragraphs.

Opportunity Cost of Wood Gatherer's Time

2.16 The amount of time villagers spend on fuelwood collection activities is one indication of the social cost or value of fuelwood supply. Time spent per household on fuelwood gathering activities may range from one-half hour per day in wood-rich environments to 5 hours/day in the desert areas of the Sahel. The economic cost of fuelwood gathering is seen as the alternative ways in which household labor could have been employed., e.g. subsistence production, cash cropping, food preparation, etc. By analyzing the labor inputs and the value of the output for these alternative activities, the marginal productivity of labor can be estimated. The prevailaing minimum wage rate for an unskilled agricultural worker can be used as a rough substitute for this estimate to obtain the economic value of the wood gatherer's time. Dividing this figure by the amount of wood gathered per unit of time, we arrive at an approximate value for a unit of fuelwood.

2.17 In practice, the labor opportunity cost method is data-intensive and time-consuming. Since little is known about how people in rural areas spend their time, a field-based time-and-motion study may have to be made. Another problem is that rural minimum wages may be

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9/ Wilson, J. L., 1982: Integrated Sawlog/Pulpwood Harvesting Trials: Western Kenya. Technical Co-operation Programme TCP/KEN/0001, FAO, Rome.

10/ An example of the types of losses that can be sustained when trees are sold by auction is given in Annex 1.

fixed by decree or government example. Thus they may not reflect labor opportunity costs in areas of high under-employement or unemployment. World Bank or United Nations reports can be consulted to obtain data on shadow wage rates for rural labor in some countries.

2.18 A more serious criticism of the labor opportunity cost method is the same one leveled against the residual stumpage approach. That is, there is no compelling evidence that the time devoted by rural wood producers internalizes the value of a standing tree. What we usually see are surrogate market transactions for the cutting, splitting and local haulage of firewood, much as these same costs may be directly observed as cash transactions in market methods. A labor opportunity cost value for fuelwood should thus be considered a lower bound figure for fuelwood stumpage.

2.19 The above problems can be illustrated with a ıictitious example. A village study was undertaken in two periods, five years apart, namely in July 1983 and July 1988. The results in Table 2.2 were obtained from observation of the village fuelwood collectors.

Table 2.2: RESULTS OF A VILLAGE FUELWOOD COLLECTION SURVEY

Species collected	Year 1983 Acacia sp	Year 1988 Acacia sp
Average weight of a headload (kg)	22.3	21.9
Moisture content (dry basis) %	12	16
Headload weight without water (0% mc) (kg)	19.9	18.9
Energy value of headload (MJ)	366	347
Solid volume (liters)	26.8	26.3
Percentage stemwood on the trees	56	62
Percentage branchwood on the trees	44	38
Percentage of wood not collected (small twigs, chips etc.)	8	5
Distance to the collecting area (km)	3.9	6.3
Time walking to collection ground (min)	52	84
Time walking back from collecting ground	66	105
Total walking time (mins)	118	189
Time to collect and prepare headload (min)	26	33
Hourly rate unskilled labor July 88 terms rural area (US$)	0.18	0.18
Shadow price of labor in July 88 terms ($)	0.12	0.12

2.20 Table 2.3 shows the stumpage values estimated using the data in Table 2.2.

Table 2.3: STUMPAGE VALUE BASED ON OPPORTUNITY COST OF WOOD GATHERERS' TIME

			1983 US$			1988 US$	
	Value of solid fuel volume per m^3		a/	b/		a/	b/
i)	Total walking and collection time c/	(144 min)	16	11	(222 min)	25	17
ii)	Walking to and from site only	(118 min)	13	9	(189 min)	22	14
iii)	Difference in total time 1988-1983		(16)	(11)	(78 min)	9	6
	Stumpage value per m^3 of total standing volume d/						
i)	Total walking and collection time		15	10		24	16
ii)	Walking to and from site only		12	8		21	13
iii)	Difference in total time		(15)	(10)		9	6
	Stumpage value per m^3 based on stemwood only e/						
i)	Total walking and collection time		27	18		39	26
ii)	Walking to and from site only		21	14		34	21
iii)	Difference in total time		(27)	(18)		15	10

a/ Hourly unskilled labor rate (1988 value)

b/ Shadow labor rate (1988 value)

c/ Worked example $\$0.18 \times \frac{144 \text{ min}}{60 \text{ min}} \times \frac{1000 \text{ l}}{26.8 \text{ l}} = \$16$

d/ Worked example $\$16 \times \frac{(100 - 8)\%}{100\%} = \$15$ (8% of wood on the tree not used)

e/ worked example $\frac{\$15}{56\%} = \$27$ (56% of the tree wood is stem volume)

2.21 A crude opportunity cost measure of stumpage could be related to the total walking and collection time and to the mass or volume of wood collected. However, the collection time is equivalent to felling, cross cutting and extraction and therefore should be excluded. The stumpage value based on walking to and from the site is probably more pertinent. But this value is equivalent to transport costs, not the standing value of the tree. If the trees had been on the doorstep of the collectors then their walking time would have been minimal but the trees would still have value. This is why the last measure--the difference in total collection time--is perhaps the best "opportunity cost" measure of stumpage value. This measure represents a marginal analysis for it depicts the increase in cost, over time, of fuelwood collection.

bracket figure has been put down for 1983 for it can be deduced that at some time in the past dead branchwood would be lying outside the door. Thus the walking and collecting time was practically zero. Therefore the difference between then and 1983 would be approximately equal to i)--the total walking and collection time--and for 1988 the cumulative total would be the sum of all the previous marginal increases which in fact is the figure in line i). But of course we are assuming that when the dead branchwood was lying outside the door it had no value. Resource economists could counter this by saying that as soon as a product is used it has value. But what figure is to be put on a product that has grown without human intervention? This could be ascertained by another survey on peoples' willingness to pay!

2.22 Table 2.3 also gives three stumpage value figures depending on whether the value is equated to the total standing volume, the stem volume or the volume of wood actually consumed. This is a first approximation and cannot be applied to products that are converted from one form to another, such as fuelwood to charcoal. Whether to relate the value to the stem wood or to the total above-ground volume depends on how practical it is to measure total volume. It should be noted however that because these particular trees contain useable branch wood the stumpage value based on stemwood measure is over 50% higher than the solid fuel volume value.

2.23 Table 2.2 shows that the "energy" quality of wood collected in 1983 was higher than that collected in 1988 because it was drier and thus had more useful energy per unit of measure. In our particular example the 1983 wood had an energy value of 16.4 MJ/kg and the 1988 wood a value of 15.8 MJ/kg, or about a 4 percent difference. This difference should be taken into consideration when working out a stumpage value, especially if it is based on weight. Freshly felled wood can contain over 50 percent water where as dry wood contains only about 15 percent. In volume terms there is only about 5 to 10 percent shrinkage between "green" wood and dry wood but, when burnt, green wood yields less energy per unit of dry matter because energy is required to drive off the water.

2.24 Finally like many other methods that try to fix a stumpage value for wood this method assumes, incorrectly, that there is only end use for the product.

Differential Land Values

2.25 Sometimes, the value of a natural amenity, such as a forest, bacomes a factor in the price of marketable assets. An analysis of the price differentials of such assets may help determine the implicit value of the natural amenity. The differential land value approach is based on this principle and is applied to the valuation of timber resources, but is less commonly seen in fuelwood contexts. To use the method one needs to know the sales prices or exchange values of comparable parcels of land, some stocked with fuelwood resources and the other practically empty of trees. If the lands are otherwise similar in terms of location, access, terrain, soil fertility, etc. observed diferences in acreage values must be due to the presence or absence of fuelwood. Estimating the yield of fuelwood harvest leads to a unit value of wood, or so the theory states.

2.26 Though this procedure for deriving the stumpage value of fuelwood in woodlands or open forest is theoretically sound, it suffers from limitations of availability and accuracy of data. Traditional land values may be expressed in non-monetary terms, which require rough translation to cash equivalents, or the land tenure system may be such that actual land alienation and exchange never occur. Even if observable, land prices are based on numerous factors, not all of which will be comparable as the method suggests. Also the additional amenity value only remains as long as the forest is left standing. This value is lost as soon as the forest is clearfelled. To keep the amenity value one would need a system of management that does selective felling in patches rather than clearfelling.

Cost-based Approaches

2.27 The methodologies we have descrived so far look at the problem of estimating fuelwood values from the benefit side, by examining consumers' actual or apparent willingness to pay for the cooking and heating that fuelwood provides. Other approaches, equally productive, look at the cost side, at the inputs needed to obtain the supply of fuelwood or substitutes of cooking or heating.

Alternative Fuel Substitution

2.28 To try to overcome the problems of price fixing or subsidies affecting the fuelwood trade, we can look at the cost of substitute products to see if fuelwood products are competitively priced. Our discussion will focus on kerosene as this is usually the most widely consumed alternative fuel to fuelwood and charcoal. 11/

2.29 For economic analysis there are adjustments required when using this method similar to those earlier described, such as taking into account subsidies and fixed prices which may not fully reflect kerosene transport and distribution costs to rural areas. Also, in most developing countries kerosene is imported or refined from imported crude. Thus the currency exchange rate affects the price of imported products. Many developing countries have an over-valued currency which lowers the price of imported products in terms of local currency. This

11/ In wood-depleted areas, agricultural residues commonly substitute for fuelwood. In this case, the value of fuelwood may be inferred by estimating any loss of agricultural productivity resulting from the removal of the residues. See paragraph 1.19.

difficulty can be overcome by applying a shadow exchange rate, if available, or some other suitable rate such as the parallel market rate.

2.30 Table 2.4 shows how a price for charcoal is obtained based on alternative fuel substitution. A first analysis of the table indicates that the market price of charcoal in Nairobi (Kenya) is greater than the market price of kerosene, especially if households are using the traditional charcoal stove to cook with. Either the price of charcoal should drop (which would also mean lowering the residual stumpage price for wood, with existing conversion technologies) or people will be motivated to switch to the cheaper alternative fuel. Even applying a shadow exchange rate some 20 percent greater than the actual exchange rate still has kerosene as the cheaper alternative fuel to charcoal using traditional stoves. Charcoal only has an advantage over kerosene if a family is using an improved stove.

2.31 However, while the Kenyan government follows a policy of not taxing kerosene (or taxing it to a very small extent) they restrict its import for balance of payment reasons. This leads to the rent-seeking behavior of buying kerosene at the official price and reselling it at up to double the price, because demand exceeds supply at the lower price. Taking this into consideration, the price of charcoal is probably competitive with kerosene if the charcoal is bought by the bag. But some charcoal is sold by the pile or the tin at up to double the price of the bag. So the picture is complicated and the comparative analysis is not straightforward. If Kenya were to import the kerosene needed to meet desired demand then at least 20 percent more fuel would have to be imported, both in volume and value terms. This change might affect the balance of payments and reduce rural employment (fewer charcoalers, etc.)

2.32 Table 2.4 shows that with the present oil prices, kerosene is perhaps the cheapest purchased fuel in Nairobi. In other time periods and in other countries different conclusions may be drawn. Also the stove efficiency assumptions may be critical to the calculations. If these assumptions are on the high side for kerosene and on the low side for charcoal, then the substitute price in the above example could be higher than the actual selling price. So the use of accurate values in such a table is important.

2.33 The method of alternative fuel cost for determining a stumpage price for wood raw material can be a useful tool. However, it has to be combined with the residual stumpage price method to arrive at a stumpage fee and of course it assumes a single end use for the raw material.

2.34 <u>Effects of Consumer Taste</u>. We have assumed so far that charcoal (or even firewood) and kerosene are near-perfect substitutes for each other. But analysis of the household sector in Jamaica, for example, shows that this is not necessarily true. In Kingston, where the analysis was made, consumers appear to prefer charcoal to kerosene for reasons other than cost of delivered energy. Charcoal users pay a 70 percent premium to burn charcoal as compared to kerosene.

Table 2.4: 1988 KEROSENE SUBSTITUTE PRICE FOR CHARCOAL: NAIROBI, KENYA

(a) Kerosene Price per Liter at the Retail Outlet

	Kshs/l	US$/l
Actual selling price of kerosene (tax free) at retail outlet	3.47	0.18
Adjust selling price with exchange rate of KShs 22 per US$ 1/	3.96	0.18

(b) Stove Efficiency Assumptions and Energy Values of Fuels

Kerosene energy value	35 MJ per liter
Kerosene wick stove 40% efficient, therefore 1 liter of kerosene will deliver	14 MJ/l to the pot
Charcoal energy value	30 MJ per kg
Traditional charcoal metal stove 15% efficient therefore 1 kg ch. delivers	4.5 MJ/kg to the pot
Ceramic lined charcoal stove 25% efficient, therefore 1 kg ch. delivers	7.5 MJ/kg to the pot

(c) Calculated Kerosene Substitute Price for Charcoal Assuming End Use is for Cooking

	Substitute Price Per kg			Substitute Price Per 30 kg Sack		
		Actual	Shadow a/		Actual	Shadow
	US$	Ksh	Ksh	US$	Ksh	Ksh
Traditional Stove	0.06	1.10	1.32	1.74	31.76	38.19
Ceramic lined Stove	0.10	1.83	2.20	2.89	52.94	63.64

(d) Actual Selling Price including fees and taxes (Ksh)

	Per kg	Per 30 kg bag b/ c/
wet season	2.33	70.00
dry season	2.00	60.00
(govt. controlled price)	(1.50)	(45.00)

(e) Calculated Example

(traditional stove) $\frac{18 \text{ c/l}}{14 \text{ MJ/l}} \times 4.5$ MJ/kg = 5.8 cents/kg or 0.06 $/kg

a/ A shadow exchange rate of Ksh 22 = 1US$ has been used. Actual exchange rate is about KSh 18.3 = 1US$ (Sept. 88). Black market rate is KSh 22-25 = 1US$.

b/ It is assumed that the 30 kgs of charcoal is fully carbonized and all is burnable. In practic 1-2% may be charred wood with an energy value of about 22 MJ/kg and 10% may be powder an fines. The powder and fines are more difficult to burn than lump charcoal. If the fines ar not burnt then the energy value per kg of "sold" charcoal in terms of actual charcoal burnt i about 27MJ/kg.

c/ The Government controlled price for a 30 kg sack is Ksh 45 (price control act (CAP 504) 1982 amended 1983).

2.35 The preference for charcoal can be explained as follows: Charcoal is an attractive fuel for those with low incomes because it can be bought in small quantities on a daily basis, can be burned in a tire rim that has virtually no capital cost, and can be obtained almost anywhere. Kerosene, on the other hand, must be bought in minimum quantities of a quart (1.14 liters), must be burned in a stove that costs the local currency equivalent of US$30, and is not available at all times. Also, many consumers complain that food cooked on kerosene stoves smells and tastes of kerosene. For these reasons, kerosene cannot be seen as a perfect substitute for charcoal. 11/

Wood Replacement Cost

2.36 In densely populated rural and urban areas of many countries, the wood raw material is being depleted due to indiscriminate harvesting. Depletion of wood resources can take place over a number of years if the wood supply in the beginning is large in relation to demand. But, if nothing is done to correct the situation, supplies will eventually dwindle. By the time the critical point of scarcity is reached, it is too late to start planting trees to meet current demand. As the average maturity period is ten to twelve years, people may be forced to switch to other fuels such as crop residues, animal dung or oil-based fuels.

2.37 Stumpage values can be calculated on the basis of the cost of replacing the lost wood resources. Planners calculate the cost of reforestation programs and arrive at an estimated stumpage price high enough to cover costs and give a specified return on investment. Governments may then try to raise the existing stumpage fees gradually to cover the full cost of growing the trees.

2.38 Table 2.5 from the 1986 World Bank Second Wood Energy Project Staff Appraisal Report for Malawi, 12/ shows how a stumpage estimate is derived from the cost of growing plantation trees for fuelwood. In this table, existing government costs are projected over a thirty year period. In the example, it was proposed to plant 3,000 hectares over a six-year period at an average rate of 500 ha/year. After the first crop had been felled, the trees would be allowed to grow from suckers for another three rotations, so that each crop cycle would be 24 years. A discount rate of 12 percent was used to discount both the costs and the volume. Discounted costs were then divided by discounted yield to arrive

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11/ Sociological and traditional values also enter into household fuel choice. These factors may also affect the substitutability of fuels.

12/ In several World Bank reports and assessments, it has been stated that stumpage fees should be fixed so as to cover the long run marginal cost of growing the wood. This is a sound statement in theory but in practice it is almost impossible to undertake marginal cost analysis. To undertake rigorous marginal analysis, all cost and growth functions for tree production must be known. A better solution is to use average incremental costs (AIC), as in the Malawi example. AIC should not be confused with average costing procedures.

at a stumpage price of 15.3 Kwacha per solid m^3. As a result of this calculation the Government accepted the Bank's recommendation that the stumpage price for fuelwood would be increased to 3.9 MK/m^3 in March 1986 and after that at 15 percent annually in real terms until a fee of 15.3 MK/m^3 is achieved by the target date of 1996.

Table 2.5: MALAWI SECOND WOOD ENERGY PROJECT:
STUMPAGE CALCULATION FOR GOVERNMENT PLANTATION
(3,000 ha at Lilongwe) b/

Year	Costs ('000 MK) a/	Benefits ('000 m^3 Solid)
1		541.9-
2		392.6-
3		447.6-
4		469.6-
5		487.9-
6		469.7-
7		152.322
8		85.436
9-12	52.5 per year	40 per year
13		52.525
14		52.542
15-18	52.5 per year	46 per year
19		52.522
20		52.536
21-24	52.5 per year	40 per year
25		52.518
26		52.530
27-30	52.5 per year	33 per year

PDV of costs (at 12%) = 2194.1 Discounted Yield (at 12%) = 143.3

		Solid m^3		Stacked m^3
Stumpage Fee to Cover Replacement Cost	= 2194.1 / 143.3 =	15.3 mk c/	or	10.7 mk c/
January 1986 Stumpage Charge	=	2.9 mk c/	or	2.0 mk c/

a/ Base costs as of January 1986, including physical contingencies. Area planted over 6 year period with a rotation of 6 year. Year 1, 303 ha; Year 2, 494 ha; Years 3-6, 551 ha per year.

b/ The Lilongwe plantation has been used to calculate the stumpage rates, because the average above ground merchantable mean annual increment (MAI) over 4 rotations of 12 m^3 solid/ha is considered typical. The assumed average MAI per rotation is in m^3/ha 12.1; 13.9; 12.1 and 10.0 respectively.

c/ January 1986 exchange rate US$1 = 1.80 Malawian Kwacha (MK).

2.39 While the replacement cost method used in Table 2.5 is a useful tool, there are several problems with the way the calculations were made. These are discussed in the next paragraphs. 13/

2.40 First, in the table only the option of supplying fuelwood from a government-managed plantation is considered in estimating the stumpage value. But in most developing countries, government-grown plantation fuelwood supplies only a small fraction (probably less than 5 percent) of the total demand. Other sources of supply and other variable costs should have been considered in estimating the stumpage value. Alternatively, if there were no other suitable sources of supply, the costs of damage to the environment from not replacing the fuelwood (externalities) should have been factored in.

2.41 Second, in this table a flat rate fee is used, ignoring the effect of distance from the market. Stumpage fees should be on a sliding scale to take into account all the variable costs, especially the transport costs.

2.42 Third, there are cheaper ways of raising trees. In the Malawi report, the cost of raising trees in government plantations was compared with the cost of growing trees in small farmer woodlots. It was estimated that the costs of the government planting would be three times greater than for the woodlots (the respective discounted values for a 1 ha area at 12 percent discount rate were 894 Kwacha and 258 Kwacha). If the woodlot option had been chosen as the way to determine stumpage fees, the derived stumpage value might have been about 6 Kwacha per m^3 (instead of 15.3 Kwacha) provided the yields of wood from the two options were about the same.

2.43 Fourth, the discount rate chosen can have a significant effect on the derived stumpage value. In Table 2.5, a discount rate of 12 percent was used. Later, after reconsideration, this rate was changed to 8 percent. If 8 percent had been used in the table, the derived stumpage fee to cover replacement cost would have been 10.7 Kwacha per solid m^3 or nearly 5 Kwacha less per m^3 (30%) than the estimated value using the 12 percent discount rate.

2.44 Finally, if a stumpage value is based only on the replacement cost of wood in government plantations, this implies that the government has a monopoly, that it can dictate the price of wood resources, and that there are no freely available substitutes on the market. Even if this is true, it will only be true in the short run. Eventually, other producers will enter the market and will produce substitute goods. However,

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13/ Current World Bank work in Malawi has recognized the above drawbacks and has modified specific targets for stumpage fees to a general one of reaching replacement costs by 1996 using a number of options for growing trees. Also the monitoring and revenue collection system is being improved to ensure that more money is collected by Government.

government stumpage fees may set a "leading price" for private wood producers and consumers, and thus influence the stumpage prices obtained by private producers.

2.45 The above criticisms of Table 2.5 do not make the replacement cost method less valid, but point out some of the factors that we must take into account when using the method. We must consider all the ways of growing and managing trees, factor in distance from the market and other variables, and critically examine costs and yield to see where costs can be reduced and yields increased. Also the cost and availability of substitute goods should be built into forecasts to estimate their market share and to see how much reliance must be placed on wood raw material to meet future energy demands.

III. FUELWOOD STUMPAGE FEE SYSTEMS IN PRACTICE

3.1 In the preceding sections, we have presented the economic justification for charging fees for fuelwood stumpage and described various methods used for estimating stumpage values. This section looks at the practical application of stumpage fees.

3.2 Today, not all countries charge a stumpage for fuelwood, Botswana being a case in point. Also, most LDCs do not charge for fuelwood if it is for self consumption because it is difficult if not impossible to collect from a large number of self consumers. However, as soon as wood products become commercialized, the levying of fees is possible especially if production is concentrated.

3.3 The bulk of wood raw material, especially fuelwood, originates from government land. Therefore, examples of stumpage fee systems will be given from state forest services. In some LDCs private individuals or institutions grow wood for sale. The individual will try to maximize the income from the sale of wood and would take into consideration end use or uses and distance from the market. This is only partially done by forest services as the examples from four African countries--Zambia, Malawi, Rwanda and Niger--will illustrate.

3.4 Table 3.1 shows the Zambian government's revised fees for forest products, published in March, 1988. In principle the fees are a flat rate but they vary according to end use, species, or product size.

3.5 The table illustrates a number of problems mentioned in Section I:

(a) Flat rate fees on products ignore the variable of distance from the markets. Transport costs can greatly influence the selling price of a wood product, especially firewood and charcoal; a charcoal producer near the market can sell a sack of charcoal for a much higher price than one remote from the market. Thus the grower of the wood raw material should be able to command a higher price if he is situated close to the market;

(b) In Zambia, wood for fuel is sold not standing but either stacked or as a fee on the finished charcoal product. Though it is easier and less time-consuming to charge for the semi-finished or finished product than to charge for the wood raw material (the standing tree), this is only a second-best solution. Charging for the product lessens the incentive of the buyer to make full, efficient use of the material. For instance, if a charcoal producer pays only for the wood removed in the form of charcoal (and perhaps some poles), he has little incentive to use all sizes of wood, a greater mix of species, to process the wood efficently, and to try to market all of his charcoal, including the powder and fines. One way around this problem is to auction the trees or sell them by tender and specify that all wood is to be removed, the site is to be left in a clean condition, etc. If there are many potential purchasers, and no collusion between the buyers, the price bid should reflect the true market price, taking into consideration the quality and quantity of the wood and other products and the distance from the markets. In practice, it is not often feasible to use this approach for fuelwood. While levying a charge on the product is a second-best solution, at least some of the raw material value will be captured;

(c) When the same wood product is sold in different units, or the unit is not clearly specified--in this example, fuelwood is charged by the stacked cubic meter, the cord or the head load--the price charged for the same product can vary widely. In the Zambian case, the charges for the stacked wood, cord, and headload are ZK 4.8, ZK 4.2 and ZK 15.2 respectively per solid m^3. Because of this difference, the poorest sector of the community, who usually buy by the head load and carry away the wood themselves, are being asked to pay more than three times the amount paid by the charcoal producers and fuelwood merchants who purchase in bulk. If the charcoal producer pays for the wood via the sack of charcoal rather than the stack of wood he is even paying less. An efficient producer will pay the equivalent of about ZK 1.6 per solid m^3 whereas the inefficient producer will pay as little as ZK 1.0 per solid m^3;

(d) If the unit of measure on which the fee is levied is not precise then significant differences of interpretation between the buyer and seller can and do occur. In Table 3.1 the solid cubic meter is the only precise measure; all the other measures are variable. A well-piled stacked cubic meter may contain 0.65 m^3 solid whereas a poorly stacked one may only have 0.33 m^3 solid, or half as much as the well stacked wood. Obviously the buyer will favour the measure based on the well stacked pile but the seller should favour the loosely stacked pile. In West Africa the stere or stacked cubic meter is the common measure and this leads to many anomalies. Likewise the bag of charcoal is an inprecise measure. In Zambia there are three sizes of bags containing approximately 25 kg, 30 kg and 40 kg of charcoal. If the fee is levied by the bag then the producer will be foolish to use small bags. This is the case in the Sudan where the producer packs the charcoal in large sacks containing up to 100 kg of charcoal. Once the fee has been paid the charcoal is transported to a depot where it is repacked into smaller sacks. In order to reduce the degree of interpretation the selling unit should be as precise as possible, such as the solid cubic meter or the weight of wood at a given moisture content.

(e) Forest services need to revise their fees and taxes often. The Zambian fees quoted in Table 3.1 were published about eight years after they were first proposed, and therefore were out of date as soon as they came into effect. In Sudan, stumpage rates and other forest fees have not been revised since the 1930s. As forest service fees generally have to be approved by the government in developing countries, the issue of fee revision can become politically sensitive, and the process is usually slow. But in most cases, if realistic stumpage fees were set and the charges properly collected, the money obtained would more than pay for an improved forest service, and investments in wood production.

Table 3.1: ZAMBIA 1988 - FEES AND PRICES FOR FOREST PRODUCTS
(Revised March 25, 1988)

	Part I	Per tree	Per Cubic Meter
		-------Units/Kwacha a/-------	
	A Timber		
001	Afzelia quanzensis	35.00	80.00
002	Alvizia species	25.00	60.00
003	Baikiaea plurijuga	37.00	90.00
:		:	:
011	Pterocarpus angolensis	40.00	100.00
012	Other species	12.00	20.00
	B Poles b/	Kwacha	
021	Poles not exceeding 14 cm butt diameters	0.20 each	
022	Poles between 15 and 19 cm butt diameters	0.50 each	
025	Bamboo	1.50 per 20 canes	
	C Fuel from Indigenous Trees	Kwacha	
0.31	Stacked in cubic meter or just stacked	3.00 per m^3 stacked	
0.32	In cords 1 m xl m x 3 m	8.00 per stacked cord	
0.33	In headloads	2.50 per 5 headloads	
0.34	Charcoal c/	0.50 per standard bag	
	D Hut Material	various products and prices	
	E Miscellaneous	various products and prices	
	Part II		
	Fees and Services	various services and fees	
	Part III		
	Honey and Beeswax	various grades and charges	

a/ Official exchange rate (May 88) K7.86 = US$1 (Feb. 89) K10.00 = US$1.
Parallel market rate (May 88) K30-K40 = US$1 (Feb. 89) K80-100 = US$1.

b/ Length of poles not specified

c/ The standard bag may vary between 35 kg and 40 kg. Also there is a removal fee of K0.50 per bag.

Source: Zambia Gazette dated March 25, 1988.

3.6 Some forest services use log size to differentiate their raw material, for instance the size of sawlogs. Table 3.2 shows an example of this practice used in Malawi. Differentiating by size recognizes the fact that the larger the diameter of a log, the greater the percentage of sawnwood or charcoal that can be recovered from it, and the greater the unit price that can be obtained by selling it for poles, etc. However, like the fees in Zambia, no account is taken of distance from the market.

Table 3.2: MALAWI FOREST DEPARTMENT SALE PRICE OF STEM WOOD EX ROADSIDE a/ b/
(Kwacha per m^3 sold)

Details	Mk/m^3 c/
Under 2.5 m long and under 20 cm butt diameters	2.9
Greater than 2.5 m and up to 3.0 m in length	
Butt diameter range cms.	
20.0 - 23.9	7.9
24.0 - 27.9	10.2
28.0 - 31.9	12.5
32.0 - 35.9	14.9
36.0 - 39.9	17.2
40.0 - 43.9	19.5
44.0 - 47.9	21.9
48.0 - 51.9	24.2
52.0 - 55.9	26.6
56.0 - 59.9	28.9
60.0 - 63.9	31.2
64.0 - 67.9	33.5
68.0 and above	34.4
Greater than 3.0 m and up to 5.0 m in length	
Butt diameter range cms	
20.0 - 23.9	14.2
24.0 - 27.9	18.4
28.0 - 31.9	22.6
32.0 - 35.9	26.8
36.0 - 39.9	31.0
40.0 and above	34.4
Greater than 5.0 m and above in length	
Butt diameter range cms.	
20.0 - 23.9	15.7
24.0 - 27.9	20.4
28.0 - 31.9	27.6
32.0 and above	34.4

a/ These fees date from 1985. A revision was due in June 1988.
b/ No species are given.
c/ Current exchange rate US$1 = 2.641 M. Kwacha.
Source: Malawi Forestry Department.

3.7 Table 3.3 shows a proposed stumpage fee system developed for Rwanda in which varying fees are charged according to distance from the processor to the final market.

Table 3.3: RWANDA - PROPOSED FEE FOR CHARCOAL WOOD TO SUPPLY KIGALI a/
(Units FRw b/)

Area	Distance from Kigali Kms	Charge per Stere c/ d/ FRw	Equivalent per m^3 FRw	Stumpage Fee standing e/ (US$)
Around Kigali	0-25	1000	1540	(20)
Kibungo, Gitarama, Byumba	25-75	800	1230	(16)
Gisenyi, Ruhengeri, Kibuye Butare, Kivumu	75-150	600	925	(12)
Regions in Northeast, Southwest, East	150 plus	400	615	(8)

a/ At present there is a fixed price of FRw 400 per (standing) stere or FRw 500/stere at the roadside. However, in practice charcoal producers often pay less in some areas, sometimes as low as FRw 200/stere (standing).

b/ Current exchange rate (June 1988) US$1 = 77.37

c/ Stere = Stacked cubic meter which should contain between 0.60 m^3 and 0.65 m^3 solid volume.

d/ This is the price before the trees are felled and stacked. For the equivalent roadside price (that is after felling, cross-cutting and stacking) add another FRw 100.

e/ Assuming an average stacking percentage of 65.

Source: Robert van der Plas, World Bank Office Memorandum of March 1, 1988.

3.8 If this proposed fee system is adopted for Rwanda, the rates shown in the table may have to be adjusted because of resistance by the charcoal producers. Also, the additional fee charged for saving on haulage works out at between FRw 26 (US 33 cents) and FRw 36 (US 47 cents) per tonne-km, which is very high. A difference of FRw 50 to FRw 80 per stere (12 to 13 cents per t/km) between each of the four areas may be more realistic.

3.9 A plan to rationalize fuelwood supply, proposed for Niger, illustrates the application of a "second best" but workable firewood fee. Fuelwood is the major source of energy in Niger and is used by 98 percent of the households. Although complete data are not available, it is widely accepted that the rate of consumption of fuelwood greatly exceeds the rate of natural regeneration in many environmentally vulnerable areas. Especially, the concentrated and intense over-expoitation of the natural forest cover around the urban areas has led to increased degredation in those zones. The urban population is largely unaware of this problem as the market supplies the consumer with a steady, uninterrupted supply at the prices shown in Table 3.4. Despite substantial nominal increases in prices of firewood, prices in constant terms have not risen, and in fact have even decreased.

Table 3.4: FIREWOOD PRICE BUILD-UP: NIAMEY, NIGER 1986 a/

	FCFA/kg	%
Purchase price at source (already cut)	2.4	15
Firewood fees	0.2	1
Transport costs	4.8	31
Wholesale margin	2.2	14
Wholesale price	9.6	61
Distribution costs	1.0	6
Retail margin	4.9	32
Retail price	15.5	99

a/ Costs (May 1986) are based on firewood transported by trucks and sold in the Niamey area. Exchange rate of FCFA 329 = US$1.00.

3.10 The replacement costs of firewood through reforestation schemes are estimated to be:

Terraced irrigation tree plantations	-	CFAF 170/kg
Rain-fed tree plantations	-	CFAF 85-130/kg
Rural private tree plantations	-	CFAF 30-60/kg

Such investments and costs are not sustainable and would represent a heavy burden if they had to be passed on to consumers. An alternative approach starts from the premise that, with proper cutting and management, firewood yields of the forested area around Niamey could be doubled and sustained over the long-term. This has been tested under a forestry project (Guesselbodi) financed by USAID, where it has been demonstrated that managing and protecting the forest cover against overuse can lead to an increase in firewood supply at a cost of between CFAF 16 and 30/kg. So, a conservative calculation indicates that the economic cost of firewood supply to Niamey is at least FCFA 32/kg, or twice the market price.

3.11 At present, there is no incentive for local villagers to invest in managing or protecting the forest cover because they cannot legally keep others from exploiting their investment, given the ambiguous nature of wood stock property rights. Existing legislation allows for partial or total handing over of responsibility and authority for the management of the forest cover to the local community. If this were done, it would make the task of regenerating forest cover around urban areas easier, provided financial incentives were used to encourage community initiatives.

3.12 The Government of Niger has decided, under a proposed IDA forestry project (Credit 1226-NR), to promote and support management of the wood stock by local people. A combined wood stock management and firewood supply system will be created through the following steps:

(a) Zoning of areas around urban centers according to their firewood production potential.

(b) Development of a system for controlling and monitoring the trade in firewood and assessing fees. Urban check points would be created and rural firewood markets would be sited in areas of high firewood production potential.

(c) Creation of incentives for local people to manage firewood resources rationally by vesting them with property rights contingent on adequate management, guaranteeing them stable urban market demand for fuelwood produced, and earmarking taxes levied on the trade to finance resource management costs.

3.13 Fiscal details have not yet been finalized, but the approximate firewood fee levels are to be as follows:

Table 3.5: PROPOSED NIAMEY REGION FIREWOOD FEE

Component		FCFA/kg
Development fee		5
Resource management fee		2
Distance-related fee	variable:	0-2
Administration fee		1
	Total:	8-10

Source: Niger Household Energy Conservation and Substituion, Report #082/88, UNDP/World Bank, January 1988.

The proposed levies are to be phased in gradually, and adjusted annually thereafter following an established formula. The first three fee elements are an attempt to capture at least part of the economic stumpage value. The last element is designed to cover the costs of administration and fee collection.

3.14 The Niger firewood fee assessment scheme, in its present formulation, does not discriminate between plantation grown and naturally regenerated fuelwood. As such, it could potentially have a depressing effect on incentives to establish private fuelwood plantations. However, under the dry Nigerien conditions, it is safely assumed that the bulk of future firewood supply will be derived through managed regeneration. The remaining disadvantages are probably outweighed by the high costs of the alternative--doing nothing.

IV. CONCLUSIONS

4.1 In most developing countries the internal trade in wood products, especially fuelwood and charcoal, is very large. In Africa alone the annual value of traded fuelwood and charcoal is probably in excess of US$2,000 million while the annual total "value" of these products (including self collected fuelwood) may be in the region of $6,000 million to $8,000 million. This trade in wood energy supports a large number of people in processing, distribution and marketing, yet the value of the wood, the raw material on which the whole trade depends, is in most cases insufficient to ensure that it will remain a renewable resource. The actual stumpage fees collected by African governments for fuelwood and charcoalwood could be in the region of $30 million per annum or about 2% of the selling price of the finished products. If trees are treated as a minable resource not only will it adversely affect the economies of these countries but will surely cause long term environmental damage.

4.2 In most countries the rationale for fixing stumpage fees is little understood, and the collection of existing fees poorly undertaken. Very few people expect oil to be free, but most assume that woodfuel is free. This may be because most trees grow without help, but oil has to be won from the ground in a few restricted locations and its processing easily controlled. In addition, most governments are unaware of the size of the trade in wood products and few realize that if an adequate stumpage fee was charged they could not only finance the investments required in the forest sector, but by taxing the wood products have some revenue for general development as well.

4.3 This paper has looked at the ways of assessing the value of the wood raw material. Valuation should at least be based on the cost of substitute goods provided the wood product has competitive substitutes. This is one way to determine stumpage value, the comparative cost of alternatives. However, in general the long run replacement cost is the most satisfactory method to use, but it must be remembered that production techniques vary enormously and all tree growing methods must be examined, not just the relatively expensive plantation techniques. Distance from the market or processing factory is an important component and must be included in the calculations. And because trees have many functions and wood raw material has several end uses, which may change over time, a knowledge of the potential market is vital; thus the value of the trees may be location and time-specific. Hence, other approaches are described to detrmine stumpage values, namely, the sale of the standing crop, the residual stumpage value and the surrogate market approaches.

4.4 Because of market distortions--subsidies, taxes, imperfect competition, etc.--arriving at a value for the raw material grown in scattered locations is not easy. Because the production process usually takes much more than a year, a rate of discount has to be included in the calculations and the assumed discount rate may have a significant influence on the replacement cost value. Nevertheless, until adequate stumpage fees are levied and collected by the tree owners, very little investment will occur in the forestry sector and this could lead to serious economic and environmental problems.

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Annex 1

THE NEED FOR MARKETING INTELLIGENCE WHEN AUCTIONING TREES--AN EXAMPLE FROM KENYA

The example is from a seven year old eucalyptus plantation grown within the city boundaries of Nairobi, Kenya. This is the second crop, but the first crop grown from suckers of E. grandis. There are 20 hectares to fell and the management unit of the forest service has estimated the volume of stem wood to be 175 m^3/ha and branchwood to be 25 m^3/ha giving a total estimated volume for the 20 hectares of 4000 m^3 stemwood and 500 m^3 branchwood - (2860 tonnes at 15% moisture content dry basis).

The present way of selling the stand is for a licensed timber contractor to come into the plantation, cut down the trees, crosscut the logs into one meter lengths, and pile the logs into stacks of one cubic meter (1 stere). The forest service will then check the measurements of the stacks, count them and charge the contractor at a fixed stumpage rate of Ksh 16 per stere (US$0.90) or about Ksh 25 per solid m^3 (US$1.40). The small branch wood and tree tops are usually not included in the pile so about 5,800 steres are counted (3770 m^3), which produces a revenue of Ksh 92,800 (US$5,155). This gives an average stumpage price of Ksh 26.5 per m^3 of stemwood or Ksh 23.2 per m^3 of stemwood plus branchwood. The cost in 1988 terms, of growing and maintaining this particular crop in the five crop cycle of E. grandis came to Ksh 48,500 (US$2,965), giving an internal rate of return of 8.6%. 1/

If a proper inventory had been undertaken it would have been discovered that in the 3500 m^3 of stemwood there were 200 m^3 of transmission poles and 1400 m^3 of building poles, whose respective stumpage fees are Ksh 130 per m^3 ($7.20) and Ksh 70 per m^3 ($3.90). Thus the income would have been as follows:

200 m^3 transmission poles	Ksh	26,000	
1400 m^3 building poles	Ksh	98,000	
2170 m^3 fuelwood (3340 Steres)	Ksh	53,440	
3770 m^3	Ksh	177,440	($9,858)

The cost of the inventory is estimated at Ksh 5,000. Thus the additional net income from proper inventory work comes to Ksh 179,640 (US$4,424) and the internal rate of return is increased to 15.1%. The stumpage value

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1/ Costs and revenues discounted back by up to 14 years for this second year rotation.

is increased to Ksh 51.3 per m^3 of stemwood or Ksh 44.9 per m^3 of total wood. 2/

However, if besides undertaking an inventory, the market price of the various products had been ascertained then the information in Table 1 could have been obtained.

The cost of gathering market information is estimated to be Ksh 3,000 thus the additional net income compared to the present way of selling the wood in Kenya could amount to some Ksh 691,080--over seven times the original income. The internal rate of return would be about 26% and the stumpage value for stem wood, Ksh 226 per m^3 ($12.50), or for total wood Ksh 198/m^3 ($11.00)

Table 1: MARKET PRICE, ESTIMATED STUMPAGE PRICE AND ESTIMATED MARKET SHARE FOR 20 ha *E. grandis*--NAIROBI, KENYA

Product	Estimated Quantity m^3	Market Price (including profit) Ksh/m^3	Estimated Stumpage Price Ksh/m^3	Total Value On the Stump Ksh
1. Small branchwood and Twigs sold ex-forest by the headload	230	150	90	20,700
2. Household fuel sold at the market	440	214	99	43,560
3. Industrial fuelwood delivered to a soap factory for boiler fuel	1,730	164	94	162,620
4. Building poles sold at the market	1,400	500	335	469,000
5. Transmission poles delivered to factory	200	600	480	96,000
Total/Average	4,000	308	198	791,880
Stem wood only	3,500		226	

If a proper inventory had been undertaken and information on market prices obtained, a standing sale by auction should have brought bids in the range of Ksh 220-226 per m^3 of stem wood.

2/ If the additional management cost is deducted from the gross revenue then the stumpage price would be reduced to Ksh 49.9 per m^3 of stemwood or Ksh 44.9 per m^3 of total wood.

Annex 2

EFFECT OF TRANSPORT AND LOCATIONAL RENTS--AN EXAMPLE FROM SUDAN

As soon as forest products become commercially important mechanized means of transport are used. Generally within a country fuelwood, charcoal, poles and sawlogs are carried by trucks, but donkey carts may be used and, occasionally, railroad cars, barges or river boats. Usually wood raw material has a relatively low value in relation to its weight. This is why, in most cases. processing takes place near the raw material source. It is also the reason why products with very little value added such as fuelwood can only be transported over relatively short distances before they price themselves out of the market. 1/ Thus, there are definite maximum distances for various forest products beyond which it becomes uneconomic to trade these goods. Of course this can vary from country to country and over time. It also depends on the size of the transport container and whether it travels empty in one direction or is moving goods in both directions. Nevertheless, there is a fairly good linear relationship between distance travelled and the cost of transport. Therefore, the closer wood is grown to the market the higher the price it should command, reflecting the saving in transport costs. When translated into stumpage terms, this transport variable gives rise to a "locational rent" component of the stumpage fee or value.

Thus, unless wood is uniformly dispersed throughout a country in relation to demand, the stumpage price should not be a flat rate. This means that the closer the raw material is to the market the more intensive the production methods could be. Therefore at the margins of economic exploitation very little effort can be put in to managing the wood resource, and the principal supply source is generally shrubs, scattered trees, unmanaged woodlands or natural forests. Near to the market, plantation grown trees may be economically viable, with a gradation of options in between.

In December 1987, the World Bank published a study entitled Vehicle Operating Costs (Chesher and Harrison 1987) which examined evidence of transport costs from Kenya, the Caribbean, Brazil and India for the period 1972 to 1982. The report looked at such factors as vehicle speed, fuel and lubricant costs, tire costs, maintenance, depreciation, interest payments and crew costs. The road surface, rise and fall, and its curvature were also taken into consideration and costs

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1/ In the subsistence sector the maximum distance that can be travelled is usually 1/2 day's walk one way although in some countries, for example, Morocco, the women may stay out overnight when collecting the winter's fuel supply. Here they generally take a donkey to bring the load back.

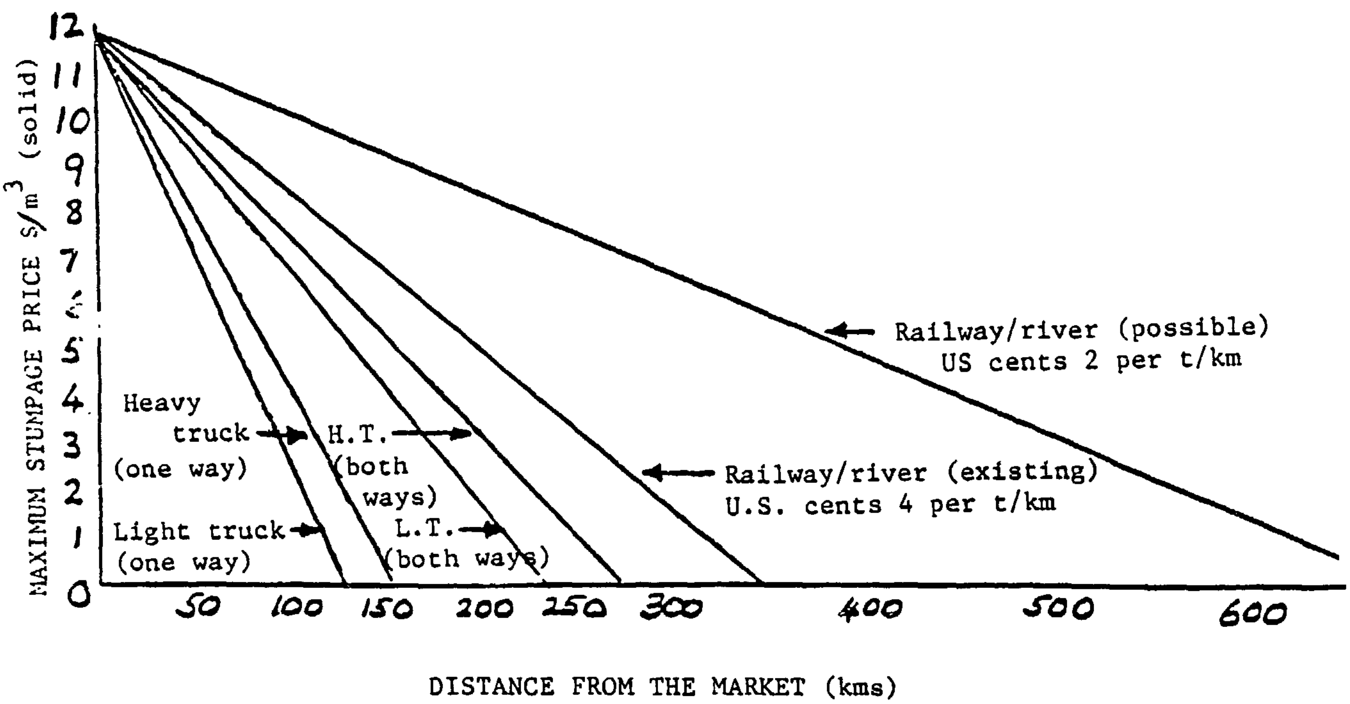
were worked out depending on these variations. For 8 to 10 tonne trucks (gross weight between 12 and 14 tonnes) the cost per tonne per kilometer (/t-km) ranged from US 1.8 to 4.3 cents in India; 2.0 to 4.0 in brazil and 4.1 to 6.8 in the Eastern Caribbean. At the lower cost end of the range were smooth surfaced roads, with 10 m rise and fall per km and 100° of curvatures per km, while at the higher cost end were rough roads with 50 m rise and fall per km and 500° of curvature per km. Similarly for a 35 t vehicle in Brazil (gross weight of 40 tonnes) the corresponding cost range was from US 1.1 to 2.3 cents /t-km. It is assumed that the vehicles in question were fully laden and thus the unladen cost per tonne-km should be less by about 20%. A similar study was undertaken in the Sudan in the early 1980s by the National Energy Administration. They found that on surfaced roads the average cost per tonne-km (including operator's profit) for a light truck (6-8 tonne) was US 6 cents, and for a heavy truck (25 tonne) US 5 cents. The railways and river corporation quoted a cost of US 4 cents per tonne-km, but it was indicated they could be profitable with a rate as low as US 2 cents per tonne-km.

Using the above figures for Sudan and subtracting the cost of felling and extracting fuelwood from the wholesale price of fuelwood in Khartoum, curves can be drawn of the maximum price that could be paid for fuelwood and charoal wood at varying distances from the market with different modes of transport. This is illustrated in Figures 1 and 2.

Comparing Figures 1 and 2 it will be seen that close to the market a higher stumpage price could be obtained if the wood was sold as firewood directly rather than sold for charcoal production. However, when goods are carried in both directions the cross over point comes at a distance of about 125 km from the market and then a higher price could be obtained for charcoal wood. In practice in Sudan households generally prefer charcoal, whereas bakeries require firewood. Thus, there is a much larger demand for charcoal and much of the wood that supplies charcoal for Khartoum comes from well over 125 km away.

In Sudan, the present stumpage fee and taxes levied on the wood raw material amounts to about US$0.50 per m^3 with a slight increase for wood nearer the market (about US$1.00 per m^3). The maximum transport haulage distance for charcoal is about 550 km. Therefore if charcoal is being made as efficiently as assumed in Figure 2 then the Government could charge between US$1.60 (light truck) and 2.70 (heavy truck) per m^3 from this distance without in theory significantly altering the market price. This would reduce the excess profits of the producers and tranporters. Some transporters in Sudan do haul only one way (but with large trucks plus trailer) therfore either the "stumpage" price under these conditions appears to be zero or the haulage cost assumptions etc. are too high. Under the above assumption, US$7.30 per m^3 is the maximum price that could be charged for charcoal wood and US$11.70 for firewood. These fees set the limits to investments that could be made in the growing of trees for woodfuel. Of course, with different assumptions and various markets for tree products, the investment possibilities can vary considerably in either direction. What the figures illustrate is the general principle that the stumpage fee should take into consideration distance to the market and that the nearer one is to the market the greater the investment can be in growing trees. However, whether the stumpage fees are sufficient to make tree growing profitable must be worked out on a case by case basis.

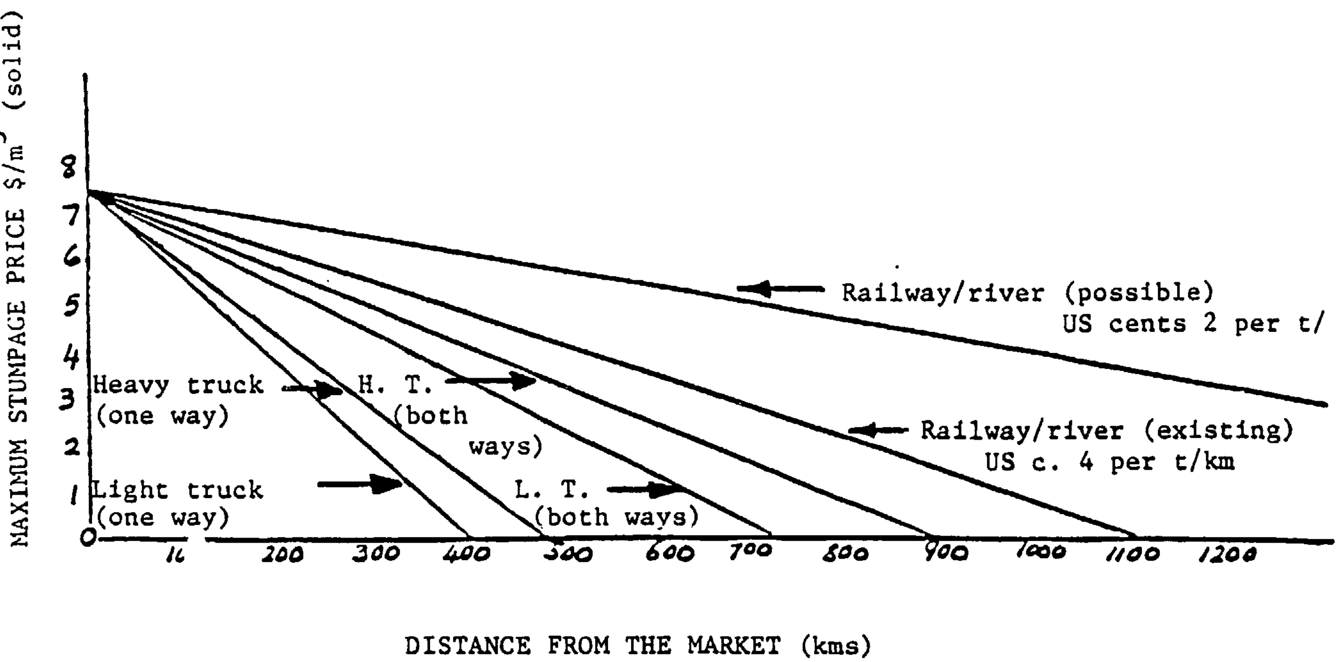
Figure 1: SUDAN 1985 MAXIMUM STUMPAGE PRICE FOR FUELWOOD AT VARYING DISTANCES FROM THE MARKET



Assumptions:

The cost of cutting, extraction and delivery to depot over 50 km of bush roads is US$13.50 per tonne. The wholesale buying price at the market is US$27.50 per tonne. 1 tonne wood (15% moisture content) = 1.2 m^3 round wood. Light truck 6-8 tonnes. Cost per tonne kilometer US 6 cents if goods carried in both directions and US 5.4 cents if goods only carried in one direction but round trip mileage taken as distance travelled. Heavy truck 25 t. Cost per t-km US 5 cents (both directions) and US 4.5 cents (one direction but twice mileage).

Figure 2: SUDAN 1985 MAXIMUM STUMPAGE PRICE FOR CHARCOAL WOOD AT VARYING DISTANCES FROM THE MARKET



Assumptions:

Cost of cutting, charcoal production and bagging US$25.00 per tonne. Cost of loading, bush transport for 50 km, unloading and storage charges at depot US$ 8.50 per tonne. Wholesale selling price at the market US$ 77.50 per tonne. Charcoal production: large efficient earth kiln using air dry wood on average requires 6.0 m^3 (5 t) to produce 1 tonne of saleable charcoal. Light truck 6-8 tonnes. Cost per tonne-kilometer US 6 cents if goods carried in both directions and US 5.4 cents if goods only carried in one direction but round trip mileage taken as distance travelled. Heavy lorry - 25 tonnes. Cost per tonne-kilometer US 5 cents (both directions) and US 4.5 cents (one direction but twice mileage).

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