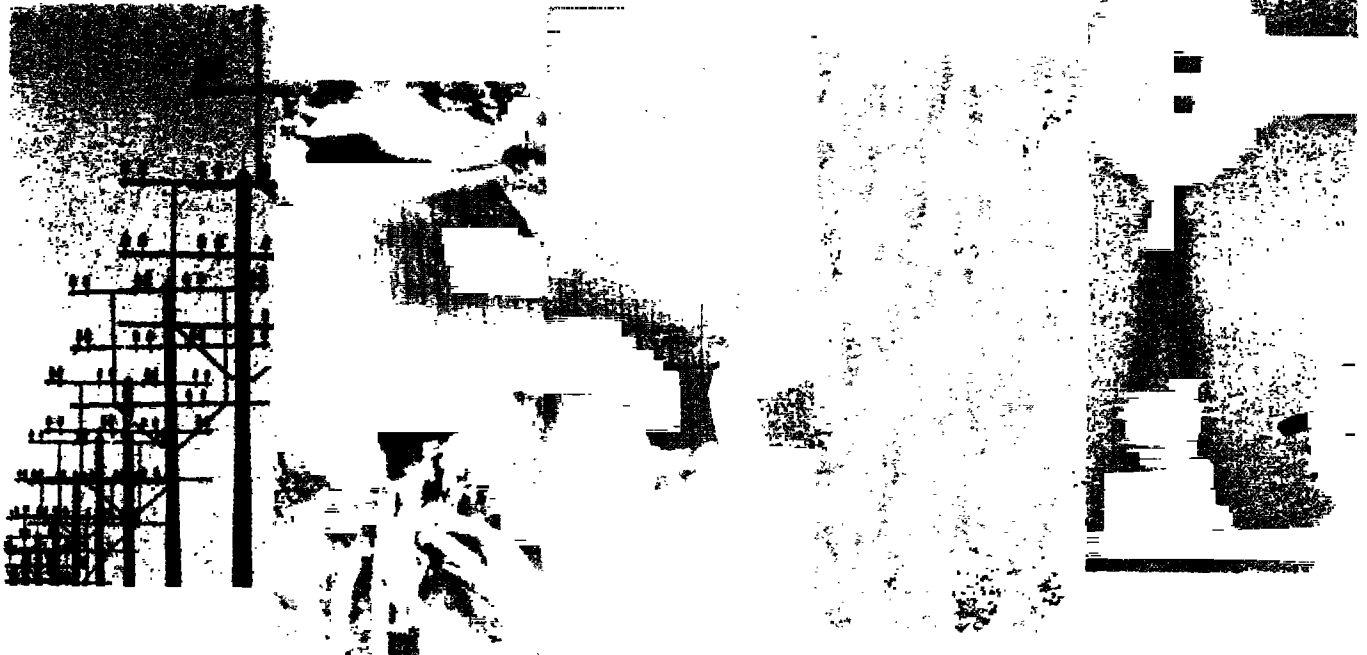


*Sustainable Woodfuel Supplies from the Dry Tropical  
Woodlands*

23486



Energy

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June 2001



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# **Sustainable Woodfuel Supplies from the Dry Tropical Woodlands**

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**June 2001**

Joint UNDP/World Bank Energy Sector Management Assistance Programme  
(ESMAP)

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## Abbreviations, Acronyms, Conversion Factors

CILSS	Comité Interétats de Lutte contre la Sécheresse dans la Sahel
ESMAP	Energy Sector Management Assistance Program
FAO	Food and Agricultural Organisation of the United Nations
ha	hectare
km	kilometre
m <sup>3</sup>	cubic metre
RPTES	Review of Policies in the Traditional Energy Sector (World Bank)
UNEP	United Nations Environment Program
USAID	United States Agency for International Development

### Conversion Factors

Conventional forestry studies tend to measure wood by volume. The most common units used are the stère and the solid cubic metre. The stère is a loosely stacked cubic metre and is usually applied to fuelwood. The solid cubic metre refers to tightly stacked regularly sized wood.

Woodfuel consumption figures are usually given by weight. As the densities of the various types of wood used for fuel vary considerably, this can produce significant errors when converting between weight and volume units and considerable caution is required when using any such figures. Unless otherwise noted, the following commonly accepted approximate conversion factors from wood volumes to weights have been used in this study.

1 stère = 300 kg;

1 solid cubic metre (m<sup>3</sup>) = 670 kg

### Note On Nomenclature

The terms woodfuel and fuelwood are widely used in the literature. In this review, “woodfuel” is used to cover both firewood and charcoal. Fuelwood and firewood are used interchangeably.

The official title of the state Forestry Service varies between countries; for convenience, the designation forest service is used here.

# Introduction

The dry tropical woodlands<sup>1</sup> cover substantial areas of the developing world. Although they are most notably found in Africa – on which this review is primarily focused – extensive areas also occur in Asia and Latin America.

These woodlands provide around 80 percent of the energy needs of both urban and rural populations in Africa and are of similar importance on a more localised scale in other areas. They also provide livestock fodder, building poles and many of the daily needs of the rural people living in and around them.

Concerns about the degradation and depletion of these woodlands date back a long time. Even in the late nineteenth century, colonial foresters were warning that the natural woodlands were disappearing in Africa. The 1970s and 1980s brought major fears that the disappearance of the natural woodlands in the developing world would bring severe rural and urban energy shortages as well as disastrous consequences for agriculture and the natural environment.

Large numbers of woodfuel projects were launched but it soon became evident that many had started with simplistic views of the problems they were addressing. The diversity and complexity of the natural woodlands themselves and how they fit into the social and economic patterns of those living in and around them were often underestimated or ignored. Many of the proposed solutions were impractical or depended on continued inputs of labour and materials that were not available in the long term. Others made unrealistic demands on local administrations and institutions.

Even more importantly, it began to emerge that there were serious flaws in the woodfuel supply and demand analysis on which the great majority of these woodfuel projects were based. The local energy “crises” many projects were designed to address turned out to be greatly exaggerated. Measures designed to deal with woodfuel scarcity were undermined by the sheer abundance of supplies.

This has led to a gradual evolution and change in thinking on the part of those involved in the woodfuel area. Much of the orthodoxy has been coming under question since the late 1980s. The newly emerging consensus suggests that the danger posed by woodfuel harvesting is far less than previously supposed and that the “woodfuel crisis” has been greatly exaggerated. If the dry tropical woodlands are in danger, it is not because they are being depleted by woodfuel harvesting but because they are of little, if any, economic, as opposed to environmental or social, value. It may even be that woodfuel harvesting, rather than being a threat to their continued existence, can provide an economic reason for their preservation.

This review attempts to pull together the various threads of these discussions. The aim is to help create a realistic basis for the formulation of future projects and longer term strategies which will enable the social, economic and environmental benefits of harvesting the dry tropical woodlands for woodfuel on a sustainable basis to be more fully realised than in the past.

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<sup>1</sup> The term woodlands is deliberately used instead of the more common “forest” to emphasise their difference from the conventional image of the temperate or moist tropical forest.

Acceptance of the new consensus requires a significant change, if not a complete reversal, in attitudes among many people. Governments, donor agencies, and, above all, forest services have taken for granted the need to protect the natural woodlands from the depredations of woodfuel harvesters. Legislative frameworks, however they have worked in practice, have been designed to restrict and control woodfuel collection. Programmes to improve the efficiency of woodstoves and charcoal-making, or shift people to the use of LPG, kerosene or even electricity, have been predicated on the need to reduce woodfuel consumption and. If woodfuel resources are plentiful, such measures are redundant or have to be justified on grounds other than their contribution to “saving the forests.”

The basic thesis of this review may therefore appear relatively polemical to some. Those to who it is not and who accept the argument that the “woodfuel crisis” has been exaggerated and that the dry tropical woodland resources are abundant will probably find the first five chapters redundant. They can go directly to the sixth and seventh chapters that deal directly with management of these woodlands for woodfuel. Others, who may need further convincing, or who are interested in how thinking<sup>2</sup> has changed over the past twenty years, may find the initial chapters relevant.

The first chapter sketches some of the main characteristics of the dry tropical woodlands. It looks at how standing stocks and sustainable yields have been estimated in the past and the general tendency towards underestimation of woodfuel resources. The second chapter provides an overview of the generally pessimistic views, which have been taken on the deforestation and degradation of the dry tropical woodlands. There are major ambiguities in the term “deforestation” and more careful analysis shows that the impact of human activities such as farming, pastoralism and woodfuel harvesting are not as great as sometimes believed. This chapter also looks at some of the real reasons why woodlands disappear. The third chapter looks at how repressive forestry legislation portrays local communities as destructively irresponsible while often preventing them from acting responsibly. It also summarises the results of a number of modern research studies, which reveal serious misinterpretations of the landscape dynamics in some of the dry tropical woodland areas.

The fourth chapter looks at emergence of the “woodfuel crisis” and the way it has permeated government and donor agency thinking. The chapter also discusses the various measures adopted in the attempt to avert the predicted crisis. The fact that despite the failure of a high proportion of the measures intended to avert it, the “woodfuel crisis” has largely failed to materialise is one of the strongest indicators that a revision in thinking is due.

The fifth chapter examines the “energy gap” analysis on which the predictions of the woodfuel “crisis” were largely based. It uses two main illustrative examples, looking in particular depth at the case of Mali. It shows how it is possible to interpret the available information in a completely different way, revealing that it is far more plausible to see such woodfuel supply systems as being in a state of dynamic equilibrium rather than a rapidly accelerating path to collapse. Adopting this viewpoint enables a more positive and creative view of woodfuel supply to be taken.

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<sup>2</sup> The present author’s among many others; those who use the benefits of hindsight to point out where others were wrong should not exempt themselves from its revealing scrutiny.

The experience to date in natural woodland management is discussed in the sixth chapter. Early attempts were expensive and unsustainable once project funding ended. Later experience suggests that many of the most costly aspects of the early programmes were not only unnecessary; in some cases they were counterproductive. Even the later projects are, however, still burdened with controls and regulations derived from the “woodfuel crisis” perspective. Further simplifications, adding to the sustainability of projects, become possible once woodfuel harvesting is seen as an opportunity rather than a threat.

The seventh chapter provides an outline approach to the sustainable management of the dry tropical woodlands. The concept of management is used in the broadest sense. Rather than attempting to develop comprehensive, but unrealisable, strategies, it is essential to look realistically at what is possible. Woodfuel harvesting must also fit within the survival strategies of the people living in and around these woodlands if they are to be expected to carry it out on a sustainable basis. Enabling and helping people to obtain the maximum benefits from the dry tropical woodlands is likely to be more productive than attempting to prevent or limit their utilisation.

A variety of examples and a number of indicative calculations, which contradict the conventional wisdom are provided throughout the text. The intention is not that these should be adopted as a new conventional wisdom; that would be absurd. It is to illustrate the variability of what is too often taken for fixed. It is also to show that the alternative figures and models can often provide a better fit with reality than those used in the past. Where this is the case, the need is for a dispassionate and open-minded re-examination rather than the substitution of a new “truth”.

This draft is being circulated for criticism and comment, which will be taken into account in preparing the final version. Any additional material or references will be gratefully received. The review is being carried out on behalf of the World Bank and thanks are due to Willem Floor for his support and encouragement. Valuable inputs have also been provided by Paul Kerkhof. Responsibility for the opinions expressed here, of course, rests solely with the author.

G. Foley



# 1

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## The Dry Tropical Woodlands

The dry tropical woodlands are the natural vegetational cover in a significant proportion of the tropics. They are adapted to the harsh and variable climatic conditions in which they are found.

The available data on the standing stocks and annual yields of these woodlands are generally uncertain and often contradictory. It is now widely accepted that many of the estimates used in woodfuel analyses in the past have tended to understate both these figures.

### 1.1 What are the dry tropical woodlands?

*It is estimated that the dry tropical woodland climatic zone occupies 1,250 million ha of which about 20 percent are covered with woodland<sup>3</sup>. The bulk of these woodlands, about 64 percent, are found in Africa. Apart from the Congo basin and a few other areas, they are the natural vegetational cover over most of the continent south of the Sahara and they are the main focus of this study.*

The dry tropical woodland description covers a range of vegetation from light scattered scrub through to relatively dense woodland. Rainfall is the main ecological determining influence but soil composition, drainage, elevation and other factors can also be important locally. In the driest areas, the woodlands merge into arid and desert margin zones where the vegetation cover becomes increasingly sparse or disappears completely.

In the low rainfall areas, below 400-600 mm per year, population densities are extremely low, typically in the range 5-10 persons per sq km. With higher rainfall and greater biomass productivity, population densities increase but are usually no more than 30 persons per sq km in most of the rural areas. Much greater densities are, however, often found in the fertile alluvial zones along large rivers and in the immediate surrounding of the larger cities.

The generic name given to the dry tropical woodlands in the Sahel is the savanna and this, in turn, is divided into a variety of sub-types. In the driest areas just south of the Sahara, the Sahelian savanna zone, the trees are generally small and widely spaced with bare or near-bare soil exposed between them. The trees have thorns, small leaves and slow overall growth rates and many are little more than bushes.

South of this, where the rainfall is higher, lies the Sudanian savanna zone in which the vegetation has a higher density with generally taller trees and a larger number of species.

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<sup>3</sup> FAO (1993).

Further south, where the rainfall is again higher, is the Guinea savanna zone where the woodlands, with a relatively dense coverage of tall trees, increasingly approximate to the conventional perception of a forest.

A common characteristic of all the savanna woodlands is the extensive occurrence of various types of grasses that once provided fodder for the large numbers of wild herbivores that traditionally inhabited these areas. In most areas, these wild herbivores have been almost entirely replaced by domesticated livestock. The quantities of grass produced are substantial. Careful measurements of an area of about 8,000 ha in Niger found that the total dry-weight production of herbaceous matter in a year of about average rainfall (567 mm) was just less than one tonne per ha.<sup>4</sup>

In central and southern Africa, the dry tropical woodlands are broadly referred to as miombo woodland. The areas covered by miombo woodland are vast; one estimate is that they cover a total of 270 million ha in seven central and southern African countries<sup>5</sup>, including most of Zambia, Malawi, northern Mozambique, central Zimbabwe, central and eastern Angola and large areas of Tanzania and Zaire.

As in the case of the savanna woodlands, there are numerous variations in the miombo woodlands depending on rainfall, soil types and temperature regimes. Among the associated vegetational types is the mopane woodland and scrub, found in areas of low rainfall and high temperatures, which covers extensive areas of Namibia and southwest Angola. The munga is an open savanna-type woodland featuring acacia species and baobabs and found along rivers and in dry flat areas of Zimbabwe.

A 1994 study of the availability of woody biomass in sub-Saharan Africa carried out by the World Bank<sup>6</sup>, used seven broad categories of woodland cover for the whole continent south of the Sahara. These range from grassland with occasional trees through to the dense forests of the Congo basin. The extent of each is shown on the map on page 17 of the study (MILLINGTON, A. C. et al (1994) *Estimating woody biomass in sub-Saharan Africa*. World Bank, Washington DC), where it can be seen that the "woodland" category, which includes both miombo and savanna, is by far the most widespread.<sup>7</sup>

### 1.1.1 *Permanent disequilibrium and high adaptive capacity*

Rainfall in the dry tropics is highly variable and proportionally more so in the drier areas. Long before any question of anthropogenic climate change arose, it was evident that many of these areas are subject to recurring cycles of severe and prolonged drought followed by periods of higher rainfall.

Rather than the steady growth and equilibrium conditions which prevail in temperate forest areas, the dry tropical woodlands are more accurately seen as existing in a permanent disequilibrium state and significant numbers of dead trees are a feature of most dry woodland areas. In the case of the Sahel:

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<sup>4</sup> Achard (1997) p19

<sup>5</sup> Chidumayo (1997).

<sup>6</sup> Millington et al (1994)

<sup>7</sup> See also Table 1.1 for estimates of the standing stock and annual yields of the various categories.



*Wooded areas may be desertified after some time while the reverse occurs in neighbouring locations. It is not clear whether the Sahelian woodland ecology should be explained by a disequilibrium model or whether it is subject to a long-term equilibrium over longer periods. In either case, the consequences for woodland management planning are significant, since the dynamics of the woodlands cannot be captured in terms of conventional forestry management tools which are based on stable, sustainable production per unit area.<sup>8</sup>*

The woodland vegetation is well adapted to deal with these conditions and when drought is severe, growth may virtually cease. Many of the important tree and shrub species have extensive root systems and much of their propagation is by new shoots from these underground networks. Even when the above ground portion of the plant is damaged by drought, lost to fire, or eaten by herbivores, regeneration and propagation can still take place.

In periods of severe drought, such as occurred in the Sahel during the 1980s, much of the vegetation may die. Large areas of dead woodlands dating from that period are still providing substantial amounts of urban woodfuel in, for example, Mali and Niger. The seeds of many of the tree species are, however, able to survive long dry periods and their regrowth in areas of apparently complete desert can be surprisingly rapid when the rains return. Once the pioneer species have been re-established, the area is then re-colonised by former species carried by the wind and animals.

There is thus an ebb and flow in the type and density of the vegetation cover in accordance with the variations in the rainfall. The sight of large numbers of dead trees has sometimes been mistaken for the permanent destruction of woodland areas but is more likely to be part of the cyclic process normal to the area. The human and animal inhabitants of these areas have traditionally moved to and fro across the landscape in accordance with these changes. It is a well-proven adaptation to climatic cycles but one, which becomes increasingly difficult, as national and ethnic frontiers are more rigidly defined.

The fluctuating nature of vegetation and climatic conditions place heavy demands on policy-makers. Problems diagnosed at one stage of a cycle may have disappeared, or intensified, at another. Similarly, solutions, which are appropriate at one stage, may be completely irrelevant at another. A high degree of flexibility and adaptability must be built into all policy prescriptions.

## **1.2 Estimating standing stocks and yields**

In conventional commercial forestry, the standing stock is the volume of saleable wood, which can be recovered when an area of forest is clear-felled. There are well-developed forest-inventory methodologies, based on sample measurements, which can be used to obtain an estimate of the standing stock, and hence commercial value, of any particular area of forest.

The annual yield, or increment, is the volume of useable timber added to an area of forest each year. It is a varying figure, being most rapid in the early stages of forest growth and gradually tapering off as the forest matures; in a fully mature, or climax, forest, the net

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<sup>8</sup> Kerkhof (1998)

annual increment is close to zero. In a plantation, where all the trees are the same age, the annual increment provides a basis for estimating the rate at which value is being added. As the plantation matures and the rate of growth declines, a stage is reached when it becomes financially preferable to harvest the plantation rather than leave it growing. In a mixed-age area of forest, the net annual increment provides a measure of the amount of wood, which can be removed annually without progressively reducing the volume of the standing stock; it is also called the sustainable yield.

The forest management techniques and measurement methods used by the early colonial forest services in the developing world were imported directly from European forest practices or adapted from them. This was reasonable since the work of these forest services was almost exclusively concerned with commercial wood production. Timber was required for construction, furniture making, veneers and other uses. Sugar mills and other rural industries used wood for their boilers; railways depended on the local forests for woodfuel, sleepers and telegraph poles. Some of this commercial wood often came from reserved state forests under the charge of national forest services, with commercial users paying a small royalty for what they extracted. Many forest services were also responsible for plantations, often in peri-urban areas, which provided a small proportion of urban woodfuel and general timber needs.

### *1.2.1 Difficulties in estimating standing stocks and yields*

When questions began to arise about the adequacy of woodfuel supplies in the developing world during the 1970s, the foresters were the only people with any knowledge of forest measurement techniques. Even they, however, had little, if any, experience in measuring the standing volumes of the “woody biomass” typically used for woodfuel.

Many early estimates of woodfuel availability included only trees with a trunk diameter of 30 cm or more; others, more realistically, went down to 10 cm. The detailed standing stock estimates for each of the developing countries produced under the Global Environment Monitoring System Project carried out by FAO and UNEP in the beginning of the 1980s, for example, used the following definition:

*Gross volume over bark of free bole (from stump or buttress to crown point or first main branch) of all living trees more than 10 cm diameter at breast height.<sup>9</sup>*

While this may provide a reasonable measure of the commercial timber in an area of woodland, it seriously underestimates the availability of woodfuel, especially that used by rural people. It does not take into account the wood found in the crown and branches of the measured trees and it omits the under storey of small trees, which can be of considerable significance in woodfuel supply.

The more open the woodland, the greater the error because of the increased proportion of the total stock found in the under storey. In some cases, its volume may be nearly three times as great as that in the stem-wood covered by the conventional inventory.<sup>10</sup> The conventional inventory, in other words, may only measure a quarter of the standing stock useable as woodfuel. Another common practice in woodfuel studies is to ignore the wood

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<sup>9</sup> FAO (1981)

<sup>10</sup> Millington et al (1994) p 20

growing on farms and fallow areas. Although these areas may contribute little to commercial timber supplies, they are often highly significant as sources of woodfuel.

The sustainable annual yield concept has been used in the great majority of woodfuel studies since the 1970s. In particular, it was basis of the hugely influential 1983 FAO study of woodfuel supplies in the developing world.<sup>11</sup> While apparently providing a logical and useful planning tool, the sustainable yield concept is fraught with difficulty and uncertainty when applied to woodfuel harvesting.

One of the main problems is the variety of factors, which influence the amount of growth, which takes place in an area of natural woodland from year to year. The amount of rainfall is one of the most important; estimates based on performance in a bad or a good year may be very different from the average over a longer period. Human activity can also have a significant impact. The increment in mature and unharvested woodland tends to be less than where growth has been stimulated by lopping and pollarding; areas that are being harvested for woodfuel will tend to have higher annual increments than those that are left untouched.

In the case of the 600 mm rain zone in Senegal, one authority suggests that for the first nine years after an area of woodland has been clear-cut; there is a net annual gain in the live standing stock. Beyond that while the overall standing stock continues to increase, the rate at which this is happening begins to slow; at the same time there is an increase in the number of trees dying. After about twelve years, a state of equilibrium is reached in which there is no net increase in either the living or the dead stock.<sup>12</sup>

Other factors may also have positive or negative impacts. Moderate grazing and browsing by animals tends to stimulate the growth of trees and shrubs in an area; in excess, it may result in their destruction. Removal of tall trees, allowing light to reach further down into the growing vegetation, will generally stimulate new growth. Fire which clears away excessive growth of grasses may allow trees and shrubs to grow more strongly; but if the burning is too severe, the damage may outweigh the gain.

Many early estimates of the annual yield from areas of natural woodland came from conventional foresters and clearly under-stated the amounts of woodfuel being produced. Some more recent studies have relied on observations of trial plots in which the number and volume of the growing shoots are measured each year. While these studies, often of no more than a small fraction of a hectare, can provide valuable information, it is questionable whether they can be reliably extended to cover woodfuel catchment areas of thousands of square kilometres. One study of the Sahelian woodlands says that the sustainable yield figures for all the countries in the region are "...purely conjectural."<sup>13</sup>

### 1.2.2 Available standing stock and annual yield estimates

Given the number of problems and variables, it is hardly surprising that the available standing stock and yield estimates vary greatly. In many woodfuel studies, the exact methodology used in arriving at the quoted stock and yield figures is not described and no firm judgement can be made on their reliability.

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<sup>11</sup> de Montalembert and Clement (1983)

<sup>12</sup> Jensen (1994) p31

<sup>13</sup> Jensen (1994) p26

A comprehensive study published by the World Bank<sup>14</sup> has assembled the available estimates of standing stock and sustainable annual yield for different categories of forest and woodland over the whole of sub-Saharan Africa. The data were taken from existing studies and applied to satellite images showing the main vegetation cover categories of which five, wooded grassland, shrubland, bushland and thicket, low woody biomass mosaics and woodland are relevant to this review<sup>15</sup>. Woodland, together with the bushland and thicket category, which stretches across the whole Sahel and is found also in Ethiopia and Tanzania, are the most extensive categories.

Table 1.1 is extracted from the study and gives figures for the above five land-cover categories, with further subdivisions in accordance with the available data. Both standing stock and annual yield data are provided for each class. In addition to giving the range of available values for standing stock and annual yield, the study calculated a median or central value of these for each land-cover category; where no estimates were available, these median values were derived from ecologically similar land-cover categories.

**Table 1.1: Standing Stock And Annual Yield Estimates For Different Land-Cover Areas In Sub-Saharan Africa**

Land cover category	Standing stock range t/ha	Median stock t/ha	Yield range t/ha/yr	Median yield t/ha/yr	
Wooded grassland	1.80-4.80	3.3	0.04-0.15	0.10	
	0.23-1.00	0.62		0.10	
Shrubland	6.1-11.00	8.55		0.50	
	4.50	4.50		0.50	
	5.00-11.00	10.00		0.50	
Bushland and thicket	3.70-7.50	5.60		0.50	
	7.80-20.00	13.90		0.21	
	2.00-35.00	18.51		0.21	
	3.03-30.80	16.92		0.04-0.38	0.21
	0.46-2.35	1.41		0.35	0.35
Low woody biomass mosaic	22.30	22.30	-	0.63	
	9.44-33.55	21.50	0.24-1.01	0.63	
Woodland	0.92-56.87	29.40	0.02-0.85	0.44	
	9.00-44.40	26.70	0.16-1.38	0.77	
	2.25-109.00	55.63	0.45-1.32	0.89	
	16.00-222.00	119.00	0.41-2.25	1.33	

All values are for air-dry wood.

Source: World Bank (1994)

The study emphasises “... the high degree of variability and unreliability in the data for each country and each land cover class.” It also notes that it was not possible to take account of the extensive non-forest trees and shrubs that occur in close association with villages and farmland in many areas. Nevertheless, the study notes that these trees and

<sup>14</sup> Millington et al (1994).

<sup>15</sup> The data was based largely on Millington et al (1994) *Estimating Woody Biomass in Sub-Saharan Africa*. Mapping of Land Cover Class on page 17

shrubs "...may form an important source of woodfuel for many rural people who sustainably collect woody and non-woody biomass near their homes."

A number of sources suggest that some of the figures in the table, especially those for annual yields, may be too low. A Club du Sahel study published in 1983,<sup>16</sup> for example, refers to the commonly accepted woodland productivity figures for the Sahel and Sudan zones but notes that substantially higher figures had been obtained from a number of areas where measurements had been carried out:

*There are also indications that in some places yields may be considerably higher than has previously been thought. In the Forêt Classée of Guesselbodi in Niger, initial estimates indicate substantially higher annual yields than the 0.5 m<sup>3</sup>/ha more or less generally accepted for this zone. In the Forêt Classée of Bandia in Senegal (rainfall 600-700 mm) yields from Acacia seyal forests have ranged from 0.67 to 2.35 m<sup>3</sup>/ha/yr...In the Forêts Classées of Wayen and Gonse in Upper Volta (800-900 rainfall) productivity based on four years of regrowth after cutting has been measured at 1.35 and 2 m<sup>3</sup>/ha/yr respectively.*

Studies of the "tiger bush" in Niger found that the wood stocks, of diameter 4 cm and upwards, in the vegetated strips were 27.6 tonnes per ha; averaged over the whole surface area, they were in the range 15.9-17.5 tonnes per ha.<sup>17</sup> A 1997 World Bank study of Senegal reports that earlier estimates of yields were probably too low and "...are now estimated to be between 1 ton/ha/yr and 2 ton/ha/yr, depending on the geographic location and specific stock composition."<sup>18</sup>

Figures from trial plots of a number of Zambian vegetation types also give very much higher standing stock figures and are shown in Table 1.2. The data are given for oven-dry biomass; for comparison with the more normally quoted air-dry figures, they should be increased by about 20 percent.

**Table 1.2: Standing biomass stock in different vegetation types in Zambia**

Vegetation type	Mean oven-dry biomass (tonnes/ha)				Total biomass
	Leaf	Brush	Wood Cord*	Total	
Dry evergreen forest	7.0	29	158	187	194
Wet miombo	3.3	14	76	90	93
Central dry miombo	2.6	11	58	69	72
Kalahari miombo		8	43	51	
Western dry miombo	1.9	8	43	51	53
Mopane/munga	1.9	7	38	45	47

\* Above 10 cm diameter at breast height

Source: Chidumayo (1997)

<sup>16</sup> Jackson et al (1983) p12

<sup>17</sup> Ichaou and Herbès (1997) p119

<sup>18</sup> World Bank (1997) p4

Results from Uganda suggest that the annual yield is 7.8 percent of the standing stock; these compare with the 1-3 percent figures give for the woodland category in Table 1.1. The same source, commenting on an estimated average yield of 0.9 m<sup>3</sup> per ha per year from woodlands in Malawi, remarks that this:

*...is less than 1 percent of the growing stock. Translated into rotation ages, this gives a nominal rotation of about 200 years for these areas, which is much too long. Rotation ages for woodlands are between 30 and 40 years... Thus, the yield figures are much too low.*<sup>19</sup>

There is even less information on the yields and stocks available from fallow lands. One study<sup>20</sup> carried out in the Sudan zone in Mali found major differences depending on the degree to which the fallow areas were grazed. It found that in heavily grazed fallows within 0.5 km of a village, where livestock were kept overnight during the dry season, there was virtually no regeneration but in ungrazed areas, the rate of regeneration was up to 0.8 m<sup>3</sup> per ha per year. An eight year-old fallow was found to have a stock of 3-4 m<sup>3</sup> per ha, not including the trees, mainly shea-butter and mango, which farmers left in place, of which the average number per ha was seven.

### 1.2.3 A tendency to underestimate

The main conclusion from the available information is that there is a high level of uncertainty surrounding most of the conventionally used estimates of standing stocks and annual yields in the dry tropical woodland areas. The available information also suggests that there is marked tendency to underestimate both values by substantial amounts. Omitting the wood available from farms, fallow lands and other non-woodland sources also contribute to under-estimation of available woodfuel supplies. It is also noticeable in the literature that estimates of woodfuel availability are often described as “conservative,” that is they are intended to err on the low side.

Underestimation of standing stocks and yields can have highly important practical consequences for the design of woodfuel projects. If, for example, a woodfuel plantation is being planned or local people are launching a project to promote woodfuel production, it is extremely relevant to know whether locally available natural woodland stocks are scarce or abundant. If expensive woodland management systems are being put in place, it is important to know whether their production is likely to be undercut by readily available and much cheaper wood from the local natural woodlands.

Concern over the “woodfuel crisis” and a desire to avoid complacency about over-exploitation of resources understandably makes authors cautious about their estimates of woodfuel availability. But it is important to note that this is not necessarily to err on the “safe” side; the contrary may well be the case. Under-estimates of the availability of woodfuel stocks and yields can undermine the operation of woodfuel projects, and clearly has done so in a variety of cases. The other paradoxical, and unfortunate, consequence can be that it may lead to serious under-estimation of the value of the existing natural woodlands and their potential for profitable management on a sustainable basis.

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<sup>19</sup> Openshaw (1997)

<sup>20</sup> Ohler (1985)

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## Human Impacts On The Dry Tropical Woodlands

Few areas of the dry tropical woodlands remain untouched by human activities. Agriculture and pastoralism, even traditional hunting and gathering, result in significant changes in the vegetation cover, and the plant species and wildlife distribution. Commercial woodfuel harvesting and charcoal making bring similar changes.

It is, however, a mistake to equate change with destruction. Official figures on desertification and degradation need to be interpreted with some caution. Although the natural landscape in most of the dry tropical woodland areas has been altered irrevocably by human intervention this does not mean its productive capacity has been destroyed. There is a complex interaction between human activities and natural processes, which needs to be recognised when interventions in the woodfuel sector are being considered.

### 2.1 Deforestation, degradation and desertification

The term deforestation is widely but imprecisely used. The popular picture it conveys is of large-scale commercial logging in which all the commercially valuable trees are felled and dragged out of an area of temperate or moist tropical forest leaving a completely devastated landscape.

The official definition of deforestation used by FAO, which produces most of the widely quoted statistics, is rather different, especially when applied to the dry tropical woodlands. A forest in the tropics, as defined by FAO, is an area of land not used for agriculture, in which, at least 10 percent of the area is covered by the crowns of trees growing upon it. Even lightly wooded areas of grassland can therefore fall within the “forest” definition as long as no agriculture is taking place.

Deforestation, in the strict technical sense, occurs when there is a reduction of the crown cover to less than 10 percent or when agriculture begins to take place in the area. Forest degradation, again according to the FAO definition, occurs when the tree cover in an area has been reduced but remains above 10 percent, and agriculture has not been introduced.

Both definitions are mainly relevant to commercial forestry in temperate or moist tropical forest areas and can be misleading when used with reference to the dry tropical woodlands where the natural tree cover is far lighter. The introduction of agriculture into a lightly wooded savanna area, even though it may cause little alteration in the number of healthily growing trees, for example, can result in it being added to the deforestation statistics. Outside these official FAO definitions, the terms deforestation and forest degradation are used much more loosely and often interchangeably.

Table 2.1 below is based on FAO data and gives the total areas of tropical dry woodlands for Africa, Asia and Latin America. It shows the rates at which deforestation, according to the FAO definition, of these woodlands was taking place during the 1980s.

These figures need to be interpreted with caution, bearing in mind the official definitions on which they are based. They do not mean that these huge areas have been stripped of all their trees allowing the deserts to advance across once fertile soils. They nevertheless convey an accurate impression of the massive impact of human activities on the natural landscape throughout the tropics.

**Table 2.1: Natural tropical woodland areas and deforestation by continent**

Region	Area of forest (million ha)	Annual deforestation 1981-90	
		(million ha)	%
Africa	151	1.1	0.7
Asia	41	0.5	1.1
Latin America	46	0.6	1.5
World total	238	2.2	0.9

Source: The Challenge of Sustainable Forest Management, FAO 1993

Desertification is the ultimate form of woodland degradation. When it happens, there is a complete cessation of growth and regeneration and the existing woodland vegetation dies. Although local movement and invasion of sand dunes can occur in areas where vegetation is stripped away completely, this is not usually the main cause of desertification. Rather than the desert "advancing" into an area, the usual reason for desertification is severe reduction or absence of rainfall. The crucial question is whether the drought is part of a climatic cycle or a permanent change.

Traditionally, the normal response by people living in drought-afflicted areas is to retreat and wait for nature to take its course. When this is not possible, the natural resource base can be completely overwhelmed with the development of desert conditions and the disappearance of food and animal fodder sources. It is the inability of human and animal populations to respond to the worsening conditions in the traditional way, rather than excessive woodfuel harvesting or livestock grazing which are often blamed, that lies at the root of these problems and their tragic human consequences.

## 2.2 Farming

The greatest impact on the natural woodlands is, of course, farming. Before an area can be farmed, its woodland cover must be cut and cleared, usually by burning. This automatically means it enters into the deforestation statistics. Farming, in fact, is the major cause of deforestation throughout the developing world, accounting for 90 percent or more of that recorded in most statistics.

The fact that an area of woodland is converted to farming and classified as deforested does not, however, necessarily mean it is totally or permanently denuded of trees. In traditional dry-land agriculture, locally valued trees are generally left in place when the land is cleared for agriculture. Farming is then carried out for three to five years until the fertility of the land begins to decline. The area is then abandoned and a new farming area is cleared.



The abandoned area is quickly colonised by weeds, bushes, sucker growths from old roots, and trees from windblown seeds. This regrowth restores much of the fertility of the land as the deep-growing roots of the trees reach downwards in search of nutrients, which are cycled into the land through leaf-fall. After five to ten years, the regrown area can be cleared of wood stocks, which become available for use as woodfuel, and cultivated again. If it is not cleared, there is a gradual re-emergence of what is called secondary woodland, which, after perhaps fifty years, may be virtually impossible to distinguish from the original.

An analysis of data from Burkina Faso, for example, has shown that the loss of standing stock when woodland areas are converted to agricultural uses can be surprisingly low. The average standing stocks on farming areas, because of trees left in place, was found to be 17.4 m<sup>3</sup> per ha whereas the average for woodland formations was 23 m<sup>3</sup> per ha – though this last varied between 40 m<sup>3</sup> for wooded savanna and 15 m<sup>3</sup> per ha for the more open savanna formations. The author remarks that one can presume that “...that woodland clearing for agriculture will not radically change the level of woodfuel resources.” He also adds that the annual yields from trees in the cultivated areas, because of the availability of manure and lack of competition from other trees, are likely to be higher than those in woodland areas.<sup>21</sup>

Shifting cultivation can, in practice, be a stable and effective land management system, which preserves much of the tree cover as well as the fertility of the land, provided the fallow period is long enough. It is when population density begins to increase that the problems arise with fallow systems. Because there is no longer enough land for everyone, farmers cannot allow fallow areas sufficient time for the vegetation to recover and there is a decline in the general fertility of the soil, as well as the amounts of woodfuel produced.

The compensating factor in some areas where increasing population density is causing long fallow systems to disappear is that communal land-ownership also gives way to individual plot-holding and a different and more intense form of agriculture. Experience from a wide variety of locations suggests that under these circumstances, and contrary to what might be expected, increasing population density leads to a major increase in the deliberate cultivation of trees, especially for fruit and poles. The following description is of the Kakamega district in the Kenya Highlands:<sup>22</sup>

*“...far from there being a progressive reduction of trees as population density increases, the reverse is, in fact, the case. It seems that each family, or each farm, needs a certain minimum quantity of trees and woody biomass. As farm sizes become smaller with increasing population density, the proportion of the farm devoted to tree management increases...Not only does the gross quantity of woody biomass increase, but also a greater proportion is deliberately cultivated. Natural bushland and residual riverine forest give way to planted stands of trees and hedges. Families cultivating the smallest shambas include in their production strategy a significant component of woodlots, windrows and hedges as well as fruit and shade trees.”*

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<sup>21</sup> Jensen (1994) p19

<sup>22</sup> Bradley (1991) p134

The spread of farming thus involves major changes in the natural landscape and is the major cause of officially defined deforestation. Yet many trees usually remain in this transformed landscape, growing permanently or regenerating in the fallow areas and providing fruit, wood, fodder and other products in the farming land themselves. In the dry tropical woodland areas, conversion of land to farming does not necessarily mean that the overall woodfuel resources of the landscape have been significantly reduced; it may even mean they have increased. Only a detailed local investigation will reveal exactly what is happening.

### 2.2.1 *The use of fire*

Most of the African dry tropical woodlands are burnt frequently, often annually. Some of these fires occur naturally, as a result of lightning, but the majority are set deliberately. Archaeological evidence suggests that fire has been used for at least 2,500 years in parts of Africa. There is ample reason for its use; it quickly and easily clears the land for cultivation, adding to its fertility in the process; it stimulates production of grasses for grazing; it drives game from cover, allowing them to be hunted more easily; and it is said to reduce tick and other parasite numbers.

The effects of fire can appear extremely severe but woodlands tend to recover quite rapidly. The following is a description of the effects of fire in the Guinea savanna:

*Just after the annual dry season fire, the savanna looks devastated. The trees and shrubs are leafless and have charcoal blackened barks. All that remains of the herb stratum are a few charred remains of unburned grass and a layer of ash on the soil surface...Within a week or ten days of burning, fresh green leaves will have emerged from the grass tufts and within a fortnight or so most of the trees will have burst their buds and produced their new stems and leaves. Also, most of the small trees that were scaled back to ground level will have produced new suckers.<sup>23</sup>*

Fire is, nevertheless, widely seen as highly damaging and a major cause of deforestation and woodland degradation. Governments and forest services have made many attempts to suppress or control fires rigorously but these efforts generally meet vigorous local opposition and have proved impossible to enforce effectively.

Some mitigation of the effects of fire can be achieved by careful timing since the severity of burning varies greatly depending on the time of year when the fire occurs. At the end of the growing season, for example, when grasses are still green and full of moisture, fires are less severe than at the end of the dry season. The time of day can also have an influence; early morning fires, when the air is more humid, tend to be less severe than those occurring later in the day.

Researchers in Guinea, for example, found a high awareness of all these facts on the part of local people. They noted that:

*Early in the dry season, when dew and green vegetation still enable fire to be controlled, village authorities ensure the protection of the village, forest island and certain sacred forest sites by organising localised early burning,*

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<sup>23</sup> Hopkins (1974) p64

*by cutting firebreaks, or both. Farmers also set protective early fires around their own standing crops, gallery forest plantations and, if appropriate, fallow vegetation, to protect them.*<sup>24</sup>

This is far from the wanton and ignorant behaviour commonly attributed to the rural people of the area by forestry service staff and external observers. Much of the legislation and fire-suppression effort by authorities, if it succeeds, is likely to be counterproductive since it prevents local people from acting responsibly. The build-up of dry vegetation matter, which occurs in the woodlands if fires are suppressed, can also result in greater destruction when the inevitable happens and the fire eventually occurs.

Complete elimination of fire is neither desirable nor feasible. It is a natural element in the ecology of these regions and an essential tool in the land-management strategies used by local people. Living in thatched dwellings and depending for their livelihood on their local surroundings, they have a strong vested interest in keeping the destructive powers of fire under as much control as possible. The evidence is that they are usually well able to do so when given the chance.

### **2.3 Pastoralism**

Raising cattle, sheep and goats is a critically important activity for a high proportion of people living in and around the dry tropical woodlands and is carried out by settled farmers as well as pastoralists. Transhumance, the seasonal movement of livestock flocks to grazing areas, is still widely practised in the drier areas and is an essential part of the overall survival-strategy of people living in these climatically harsh and difficult areas.

When the rainy season comes in the Sahelian area, for example, there is a mass movement of livestock herds northwards to take advantage of the new crop of grass produced by the rains in these non-farming areas. Sometimes, pastoralists arrange to include the herds of settled farmers in the process for a payment. In addition to taking advantage of the availability of fodder, this removes the livestock from the cultivated areas during the planting, growing and harvesting period. During the dry season, after the harvest has been gathered, the animal herds are moved south again.

In the absence of artificial fertilisers, these livestock herds have a vital part in maintaining the agricultural system. When they arrive in the agricultural zone during the dry season there is ample fodder available. They are able to feed on stalks and residues in the harvested croplands, breaking these down in their digestive systems and fertilising the fields with dung. Flocks are also allowed to graze in the woodlands during the daytime and are kept overnight in the cultivated areas, ensuring a transfer of soil nutrients from the woodlands to the cropped areas. Villages often have contracts, payable in millet, with the pastoralists for this fertilisation service.

The availability of browse from the natural woodlands is a crucial element in this mutual support between pastoralism and agriculture. In addition to being a source of soil nutrients for the cultivated areas, the woodland browse is essential for the survival of livestock herds during the dry season when grass and other food sources are not available. This is closely in accord with the natural ecology of these regions, with the herds of domesticated animals

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<sup>24</sup> Fairhead and Leach (1994) p230

taking the place of the wild herbivores which have been killed or driven away by hunting but would otherwise rely in the same way on these woodlands.

Long viewed as environmentally destructive, inefficient and wasteful of resources, pastoralism is gradually being recognised as a critically important element in the Sahelian ecology and the interlocking survival systems of inhabitants. A review of the role of pastoralist livestock and the environment remarks:

*Conventional wisdom suggests that much of the blame for “desertification” and land degradation in arid rangelands rests with pastoral livestock production. There is now considerable literature that corrects this misconception, on two counts: (i) the extent of dryland degradation is greatly exaggerated, because the underlying ecological dynamics have been misunderstood; and (ii) the contributory role of livestock has been mis-specified...Dryland ecosystems are now understood to be:*

*Highly variable over time, heterogeneous in space and resilient; in which*

*Long-run primary productivity is influenced more by abiotic factors such as rainfall than the density of grazing livestock within the system; and*

*The flexibility or opportunistic or ‘tracking’ strategies of mobile animals, along with many other adaptations which herders and farmers make to the vagaries of such dynamic, event-driven ecosystems, allows the exploitation of the varied ...forage quality for diverse feed sources.<sup>25</sup>*

Pastoralists live under conditions that are highly variable and almost uniformly difficult. They have a strong vested in the healthy survival of the dry tropical woodlands. Rather than being viewed as a threat and a problem, to be excluded if at all possible, they need to be seen as an essential element in any comprehensive management strategy for these woodlands.

Conflicts of interest do, of course, arise between pastoralists and local communities, at times leading to violence. Customary law and local traditional leaders normally provide mechanisms for the resolution of these disputes, allowing farmers and pastoralists, for the most part, to co-exist peacefully.<sup>26</sup> Whether this role can be played effectively by forest service officials in woodland management projects is highly questionable and needs to be considered carefully when these projects are being designed.

#### **2.4 Impact of woodfuel harvesting**

Woodfuel harvesting is widely seen as uniformly destructive and damaging. In fact, it covers a range of activities, some of which are completely benign and none as damaging as reputed.

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<sup>25</sup> Mearns (1996)

<sup>26</sup> Given the traditional power relations between certain pastoralist and farming tribes, it is another question entirely whether this conflict-resolution is necessarily “fair.”

### 2.4.1 Rural woodfuel harvesting

Women and children carry out most of the collection of woodfuel for domestic use in the rural areas. It is almost entirely outside the cash economy<sup>27</sup> and is often done in association with other activities; women returning from work in the fields may, for example, carry a bundle of firewood with them. Dry fallen branches are usually the preferred type of woodfuel and trees, which have died as a result of fire, drought or other causes, are a major source of woodfuel in many areas. Total woodfuel consumption figures vary greatly between areas, families within them and over time. Annual totals are commonly taken to be in the region 300-500 kg per head per year or 2-5 tonnes per family.

Women collecting woodfuel may carry a machete for lopping branches but large trees are rarely cut because of the amount of labour involved in felling and chopping them into pieces small enough to be carried home. A survey in the Dogon area of Mali found that woodland harvesting was highly selective. A total of 68 woody species were harvested out of which 45 were for fuelwood and 27 for construction wood; there were 22 medicinal species and edible leaves were harvested from 17 species.<sup>28</sup>

Nearby natural woodlands are often the most convenient woodfuel source but families do not clear-cut these to supply their needs; any lopping or cutting carried out in the bush is replaced by new growth and the impact is slight. Trimmings and loppings from on-farm trees can provide a convenient supplementary supply. Woodfuel is often stockpiled besides the dwelling for use in the rainy season.

Fallow lands being brought under renewed cultivation and new areas being cleared for farming provide a high proportion of farming families' needs over much of the tropical woodland area. A comment on Sahelian practices is that *"It has been a grave error to think that woodfuel has come from the exploitation of the natural savanna when, in the great majority of cases, it comes from deadwood in areas cleared for agriculture."*<sup>29</sup>

Significant changes in collection patterns can occur throughout the year, depending on the pressure of other farm duties, weather conditions, the availability of supplementary fuels and other factors. Even in areas where woodfuel resources are abundant, maize cobs, millet stalks, and other agricultural residues are widely used as supplementary fuels.

In areas where the population is increasing and the area under cultivation is expanding, the previously accessible natural woodlands may become less accessible to families seeking woodfuel and more time has to be spent on the task. For distances of a few kilometres, woodfuel collection still tends to be associated with work in the farming area and supplies are usually carried in headloads by women. For distances beyond this, donkey carts are used in some areas; sometimes women cut and stack the wood, which is then ferried back in the cart by men.

As fuel collection becomes more difficult and time-consuming, fuel use patterns change. There is a reduction in the total quantities used and a greater reliance on smaller wood sizes, maize cobs, millet stalks and other agricultural residues. Animal dung comes into

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<sup>27</sup> Occasionally, salaried officials, old or disabled people or others living in villages may buy their wood but those collecting from communal lands and the natural woodlands do not have to pay for what they obtain.

<sup>28</sup> Kerkhof (1998b)

<sup>29</sup> Bonkougou and Catinot (1986).

use, especially in the drier areas where biomass productivity is low. In Burkina Faso, a review of the country's village energy programme noted:

*"...the apparent indifference of the rural population to the benefits of improved stove use. This evaluation also noted that even in the most deforested zones, the rural population appeared adequately stocked with fuelwood and rarely cited its absence as a problem"*<sup>30</sup>

A similar observation comes from a World Bank study of West Africa:

*Rural people usually find their woodfuel on their own lands. Even in cases of extreme scarcity, energy consumption in the rural areas does not appear to degrade forest resources because consumers have turned to the use of other biomass resources.*<sup>31</sup>

The traditional three-stone cooking fire is a major element in such adjustments. It is highly flexible in use, capable of being adjusted to the size and type of fuel available. This is often forgotten when it is criticised for its inefficiency or attempts are made to persuade people to adopt improved cooking stoves in the rural areas. Surveys show that the amount of fuel used to cook a given meal on a three-stone fire can easily vary by a factor of four or five between areas where it is abundant and those where it is scarce.

Despite the commonly expressed fears, the increased use of agricultural residues and dung does not pose any serious threat to the agricultural system in the dry tropical woodland areas with their relatively low population densities and extensive agricultural systems. Consider an area with a population density of 30 persons per sq km, a relatively high figure, found only in areas of comparatively high biomass productivity. If the average annual fuel consumption of the people living in the area is 300 kg per head, this requires a burnable biomass off-take of 90 kg per ha per year.

This can be in the form of dead wood, lopped branches, twigs, bushes, millet stalks, maize cobs, cow dung and any other burnable material available. Much of this material will be of low fertiliser value but, in any case, the quantities abstracted are not so great that the agricultural system is put at risk whatever is used. Moreover, the ashes from the fire, together with other household wastes, will normally be returned to fertilise the home garden and nearby cultivated fields.

The high level of variability in woodfuel collection and use patterns means that any survey figures for rural woodfuel consumption need to be treated with caution. At best, they represent a snapshot of fuel use at a particular time. They cannot be taken as a fixed quantity, which will be consumed irrespective of the accessibility of resources, the availability of alternatives and all other factors. Rural woodfuel consumption in the dry tropical areas is a highly dynamic process in which families continually adjust and adapt to circumstances, balancing time and effort as best they can.

The result is that, rather than destroying the woodland resource base, the overall impact of rural consumption upon it is slight. Collection generally relies on dead and smaller easily collected wood rather than the larger trees typically harvested for the urban areas; much of the woodfuel comes from fallow areas; there are strong feedback mechanisms at work on

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<sup>30</sup> World Bank (1991) p10

<sup>31</sup> Jensen (1994) p8

consumption levels and supplementary fuels come into use as soon as woodfuel collection becomes difficult. When looking at supply prospects in a woodfuel catchment area in the dry tropical woodland areas, it is probably safer to ignore the impact of local woodfuel harvesting completely rather than to aggregate it with urban consumption as is sometimes done.

#### 2.4.2 Supplying urban woodfuel markets

Woodfuel harvesting for urban markets takes place on a larger, more concentrated and more organised scale than for rural consumption. The bulk of the supply for the larger urban areas is transported by truck and there is usually a well-established supply chain from the source in the natural woodlands through the urban wholesaler to the retailer and on to the final consumer. Some small-scale woodfuel collection usually occurs in the immediate urban hinterland, away from the main roads, with animal, bicycle or even head-load transport but the proportion of the total consumption supplied in this way tends to be small, especially in the larger cities.

Studies of urban woodfuel supply systems show a variety of organisational structures but the urban wholesale dealers usually have a prominent, if not a completely dominant, position. In many cases they control the transport system and thereby keep a firm grasp upon the whole trade, sometimes with the assistance of highly placed politicians and government officials. The amounts of money involved are substantial; in some of the poorer countries, woodfuel supply is one of the largest economic sectors in the whole economy.

A typical arrangement is that the wholesaler employs a gang of urban labourers as woodcutters. They are taken to an area of woodland where they cut and stack a truckload of woodfuel. The woodfuel is then transported to the urban area and passed through the distribution chain to the final consumer. In other cases, rural people themselves may cut and stack the wood and sell it to the dealer or to passing truck drivers and motorists; piles of cut and split woodfuel along the roadside are a common sight in many countries. Well-organised gangs from the urban areas often have chainsaws; rural dwellers operating on a smaller scale usually rely on traditional cutting and splitting tools.

Gangs of charcoal-makers living in the countryside usually make charcoal. They move from area to area in accordance with the availability of suitable charcoal-making trees. Charcoal kilns are almost invariably of the clay-mound type made to the local traditional design. The size of kiln and the level of skill of the charcoal makers vary, as does the efficiency of conversion of wood to charcoal.<sup>32</sup> Commercial arrangements vary, with some charcoal-makers acting as employees of urban dealers and others acting independently and selling their production at the best price they can obtain.

In general, woodfuel markets are socially and financially complex:

*Woodfuel markets are constituted of numerous interlocking markets (where credit, labor and price are interlinked). Such interlocking relations are complicated by the need to develop trust (as in a developed dependent or amicable relationship) and the transaction costs of having to return to*

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<sup>32</sup> See also Section 4.2.2

*collect debts. It becomes rapidly clear that a larger operator who can return frequently and is known in the community is at an advantage.*<sup>33</sup>

The result is that there is usually a high degree of stability and imperviousness to outside interference in these markets. New entrants can have difficulty in finding supply sources or markets for what they produce. Ambitious schemes to reorganise the woodfuel market system to the detriment of those already running it almost inevitably run into powerful opposition.

Woodfuel for the urban market generally comes from the larger woodland trees that are felled, cut and split for firewood. Charcoal makers usually work close to where the larger trees have been felled, rolling whole trunks into the kiln. Large-scale woodfuel dealers and charcoal makers, because they have the freedom of choice of location, which comes with motorised transport, can strike a balance between abundance of resources and transport costs. The natural progression is to concentrate first on the abundant and easily accessible resources nearest to the city, gradually moving to those in more distant or inaccessible areas.

The minimum tree size taken by urban woodfuel suppliers depends on the overall availability of woodfuel. Where it is abundant, only the species preferred by urban consumers will be taken and a high proportion of the supply will be in the form of split logs. Where supplies are less plentiful, tree cutting is more indiscriminate and there may be a greater proportion of smaller sizes. Even then, commercial woodfuel suppliers have no incentive to strip the land bare of its vegetation cover and they usually do not take the small diameter stems and branches used by rural people.

Woodfuel supply sources vary between countries. In most of the dry tropical woodland countries, the bulk of the woodfuel comes from the natural woodlands. A study in Malawi, however, found that 47 percent of the woodfuel supplied to the four main cities came from woodlands, with 38 percent coming from open farmland and grazing areas. The remaining 15 percent came from woodlots and plantations.<sup>34</sup>

Urban woodfuel consumption is conventionally credited with huge amounts of deforestation. Such is the power of this preconception that woodfuel analyses often remark that the aggregate consumption of a particular urban area is “...*equivalent to clearing 50,000 ha of woodland per year...*” or some such large figure. The implication is that this area of woodland is completely lost to the woodfuel supply system.

In practice, the issue is much more complex. The World Bank Household Energy Study in Niger<sup>35</sup> identified three distinct harvesting phases in woodfuel catchment areas around the major urban areas.

The first phase, when woodcutters newly move into an area, is the least destructive. Only dead wood, whether a result of drought or the natural mortality of trees, is taken.

In the second phase, the dead wood is scarcer and obtaining a load requires greater time and effort on the part of the woodcutters. Although some cutting of living trees is carried out most of the woodland stock remains intact.

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<sup>33</sup> Ribot (1995b) p53

<sup>34</sup> Openshaw (1997)

<sup>35</sup> Foley et al (1997) p24



The third phase is when all the dead wood has disappeared. Living trees are cut and left to dry before being transported to the city. This third phase strips the area of all its saleable trees.

It is important to note, however, that even in the third phase, the common assumption that once an area has been cut over for woodfuel it automatically becomes dead land for future woodfuel production is clearly false. Even if all the larger trees in an area have been removed, the capacity for regeneration is not destroyed; otherwise fallow systems would never work. The evidence is that such regeneration does, in fact, occur:

*Peasants interviewed in Niger, Burkina Faso, Mali and Senegal all claim to cut firewood and produce charcoal in the same area about every 7 to 14 years. In Senegal, the charcoal makers return to the same area approximately every 12 to 14 years. In Niger and Burkina Faso, the peasant firewood cutters claimed that one could recut an area after 7 years. In Mali they said for firewood you can cut after 3 years but for the big stems needed for charcoal you need to wait at least 7 years.<sup>36</sup>*

In addition, the greater part of the under storey in these woodlands is left in place because it has no commercial value in the urban woodfuel market. The same is true of charcoal making. A study of its impact in Tanzania, for example, remarks that:

*Woodlands appear to recover relatively well following harvesting for charcoal production. Selective harvesting, where the high quality, low cost fuel production species and specimens are culled first from a piece of land, serves to maintain the viability of the woodland resource while providing charcoal.<sup>37</sup>*

A study of the recovery of miombo woodland after charcoal making in Zambia reached virtually the same conclusions. At the exact position of the kiln, the heat is sufficient to kill off the roots and seeds in the ground but this only accounts for 2-3 percent of the harvested area. Otherwise, there is a large pool of seedlings in the herb layer and the coppicing-ability of the cut trees ensures a fairly rapid recovery; in fact, the net productivity of the area may increase from about 1 tonne per ha per year before harvesting up three times this amount. The study concludes that:

*The widespread concern about land degradation due to deforestation caused by woodfuel harvesting for urban charcoal supply in the miombo woodland region of central and southern Africa is not supported by the present results.<sup>38</sup>*

Commercial woodfuel harvesting is often socially unjust in the way it removes woodland resources from local areas without compensation to those living there. Woodfuel harvesters may pay scant regard to local needs, preferences or sensibilities when deciding which trees to cut. They may even enjoy the support of forest service officials against the villagers on the grounds that since they are in possession of a cutting permit, they can harvest where as they wish. But commercial woodfuel harvesting is generally far from its

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<sup>36</sup> Ribot (1995a)

<sup>37</sup> Hosier (1993).

<sup>38</sup> Chidumayo (1993)

common portrayal as an agent of total woodland destruction. Indeed, one author is of the view that:

*In general, woodfuel harvesting has not been a major factor in the degradation of woodland formations, up to the present, in the countries covered by the present study. Selective cutting of the commercially attractive fuelwood species, without provision for regeneration, will, however, result in a qualitative impoverishment of the woodlands.*<sup>39</sup>

In this context, it is also interesting to look at the overall impact, considered at a national level, of supplying woodfuel to a large urban concentration such as Dakar, the capital of Senegal.<sup>40</sup> Total woodfuel stocks in the country, counting trunk diameters above 10 cm, are estimated to be 139 million m<sup>3</sup>, about 95 million tonnes, excluding stocks on fallow lands. The total area of woodlands is about 11 million ha; giving an average stock of 8.6 tonnes per ha.

The total charcoal consumption in Dakar is about 150,000 tonnes per year; requiring perhaps 300,000 tonnes of wood (see section 4.2.2). At the national average stock level, the total woodland area, which must be harvested to supply this, is 35,000 ha. This is just 0.3 percent of the total wooded area in any given year; similar figures are found for other Sahelian countries. Woodfuel harvesting is not, by any means, the predominant influence upon the national woodland resource in these countries.

## **2.5 Why natural woodlands disappear**

The fact that woodfuel harvesting is much less destructive than commonly assumed does not mean that the dry tropical woodlands are not disappearing in many areas. Most large cities in the developing world, for example, have a large and expanding circle of virtually treeless land surrounding them. The reason is that woodlands are cleared when there is a more lucrative use for the land they occupy. This is true from the immediate urban surroundings to the remote and isolated areas.

It is most obvious in the peri-urban area. Houses, factories, offices, shops and other commercial uses, even carparks, provide a far higher financial yield than areas of woodland. As the urban area expands, the woodlands are cleared to make way for these uses. Along the sea coast and other areas with tourist potential, converting the natural woodlands to hotels, theme parks and golf courses produces a much greater income than leaving them intact or harvesting them for fuelwood. Only the most stringently enforced planning regulations can prevent natural woodland areas being cleared in favour of these types of commercially attractive developments.

Market gardening is another typical peri-urban land-use. The cash yield from using land to grow vegetables for the urban market may not as high as that from property development but it tends to be higher than from ordinary farming which is displaced to further out from the city. Market gardening lends itself to intensification through mechanisation and increased inputs of water, fertilisers and pesticides; so does the production of vegetables and cut flowers for export markets. Commercial enterprises with access to capital investment funds are better placed to take advantage of this type of development than

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<sup>39</sup> Jensen (1994)

<sup>40</sup> Figures are taken from World Bank (1997)

small subsistence farmers; they are also more determined to ensure that the financial return from the land is maximised. Again, there is no financial incentive to leave areas of natural woodland in place if these uses are available.

The widening circle of deforestation visible around the urban areas of the developing world is often attributed to out-of-control woodfuel cutting and seen as evidence of a rapidly escalating domestic fuel crisis. In reality, it is simply a reflection of the normal working of economic forces and the allocation of land to the most financially productive uses. From the economic, or financial, point of view it is absurd to keep peri-urban land under trees when it can be put to profitable uses. Even if all woodfuel collection were to stop, the woodlands around most cities would still be cleared.

Further, out from the city, cash crop farming also causes large-scale clearance of woodlands. Growing cotton, peanuts, maize, coffee and other products is again much more lucrative than leaving natural woodlands in place. This type of farming is carried out in areas where soil and water conditions are suitable and there is adequate access to markets for what is produced. Intensive livestock rearing, often relying on stall-feeding, can also produce substantial returns from the areas of land occupied. Woodfuel harvesting and collection of woodland products cannot compete financially with these uses.

Nor does the disappearance of the woodfuel resources nearest the city have any particular significance in the overall supply context. If an area of woodland within easy reach of the city is not guarded effectively, it is inevitable that the saleable wood upon it will be cut and sold to urban woodfuel consumers. Woodfuel harvesters from the urban area are unlikely to leave the near supplies standing while they pass by in the search for more remote sources. This will happen whether woodfuel is scarce or abundant; all that is required is that there is a market for the wood.

This is not to suggest that the land-uses, which emerge in the peri-urban areas, are the optimum from a social or environmental perspective. Many real and serious problems quite evidently arise because of misuse of land and other natural resources in these areas. However, almost invariably, these problems have little, if anything, to do with urban woodfuel use and are not susceptible to interventions in the woodfuel sector.

The answers, if they are to be found, lie in well-designed and rigorously enforced land-use policies with clear social or environmental objectives. These may include the preservation of areas of natural woodland, with or without access for woodfuel collection, but even when such policies are implemented, the financial pressure to release these lands for higher value uses will remain. This is as true of the industrial world, where peri-urban "green belts" and other reserved lands are under constant pressure, as it is in the developing countries.

### *2.5.1 Woodland areas in the survival strategies of small farmers*

The role of the woodlands in the survival strategies of small subsistence farmers also needs to be seen clearly, when interventions are being planned. Operating under difficult and unpredictable climatic and economic conditions these farmers have to adapt their activities to the prevailing circumstances and take their opportunities whenever they occur. As one observer has written:

*Economic activities tend to be opportunistic, especially in the northern Sahel. Opportunism is seen as a characteristic of nomadic pastoralism, but*

*it should be seen as equally characteristic of farming communities, in their own way. Crop production is highly variable and it is usually deficit for the majority of farming families. A range of complementary economic opportunities are seized such as temporary or long term migration, food for work, herding and woodland exploitation which constitutes a pattern of economic nomadism.*<sup>41</sup>

The first task of a family arriving in a new area is to clear away the natural woodland to obtain the necessary farming land. Subsistence food production normally has first claim on land and labour but where there is a market for cash crop production it can have equal or greater priority. Lack of fertilisers, tools, pesticides and other inputs, shortage of labour, lack of skills or knowledge, the poor quality of their land and the other burdens of poverty, automatically restrict what each family can do. They must work within this framework.

Natural woodlands, including land in various stages of fallow, operate as a land bank for the community. They are available to be cleared when farming families need to shift to a new area of cultivation as the fertility of their existing area declines or when new opportunities emerge for cash-crop cultivation; they can also be used to accommodate population growth. Such uses will always have a high priority and local people will have no compunction about clearing woodland to accommodate them.

The benefits provided by the natural woodlands are, of course, appreciated locally. They are a source of woodfuel. They provide building poles, livestock fodder, medicinal herbs, fibres, berries, honey, birds, small game and other products. In addition to meeting family needs, some of these products may also have a cash value. But the aggregate of these benefits is unlikely to be comparable with cultivation of the same land for subsistence food or cash-crop production and the woodlands will be cleared when the need for new agricultural land arises – particularly as not all these benefits disappear when the land is converted to agriculture.

Nor is commercial woodfuel harvesting by the local community necessarily a particularly attractive option. It is difficult and time-consuming work with low financial rewards for those doing the manual labour, which is significant and is often carried out by migrants or landless people in settled farming areas. Many rural dwellers will prefer to seek more lucrative work in the cities or abroad; the Niger Household Energy Project found that labour shortages were even affecting food production in some areas around Niamey. A study in Mali found that the poorest families, often those with old or ill people, did not have the capacity to exploit the local woodlands for woodfuel.<sup>42</sup>

If farm incomes increase to a level at which farmers can afford fertilisers, major change can take place. The complex interrelationship with pastoralism, and the role of the natural woodlands as a source of animal fodder and fertiliser, comes into question. The local benefits from the woodlands may not be comparable with those obtainable by clearing them and farming the land intensively.

From the viewpoint of the local people, leaving the woodlands untouched or managing them on a sustainable basis is usually a last-resort residual option, taking its place behind

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<sup>41</sup> Kerkhof et al (1998a)

<sup>42</sup> Kerkhof et al (1998b)

virtually any other potential use for the land they occupy. Climatic and soil conditions, however, greatly restrict the available alternative uses and over large areas in the dry tropics the woodlands are likely to remain in place. In seeking ways of preserving or better managing these woodlands for ecological or other broader reasons it is, however, important to recognise that local people would have few regrets at seeing them replaced by other more productive land uses if these could be found.



# 3

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## Misreading the People and the Landscape

There is a long tradition of repressive forestry legislation throughout the dry tropical areas. The direct effects are often counterproductive and the overall result is a deeply embedded tradition of distrust between forest services and local people, which remains a major obstacle to collaboration between them.

Modern research is now undermining some of the most deeply held beliefs about the evolution of the African landscape and the impact of local people upon it. The possibility that the effects of human intervention have been completely misinterpreted, or that apparently degraded dry tropical woodland landscapes are functioning at their ecological optimum needs to be borne in mind when interventions are being considered.

### 3.1 The repressive mentality

Rural people across the whole dry tropical zone have traditionally, and almost universally, been seen as environmentally irresponsible. They have long been regarded as the primary agents of woodland destruction, short-sightedly undermining the natural systems on which they, themselves, depend. Drought and climate change in the sub-Saharan region have erroneously been attributed to their actions.<sup>43</sup> More recently, they have joined the list of those responsible for global warming.

From the beginning of the colonial period, foresters felt a need to protect the natural forests against what they saw as the destructive activities of local people. Large areas of natural woodland were declared reserved forests over which forest services were given control. In a decree introduced in 1935, for example, the French colonial administration in what is now Niger, in addition to the classified forests, attributed to itself all vacant, un-owned woodland areas, which it designated as the “protected forest domain.” The role of the forest service was to patrol and guard the classified forests and the protected forest domain against the local population. The attitude of the forest service in carrying out its duties was severe and punitive and is well captured in the following remarks of an old forest warden.

*"At that time the forestry service was very harsh with the local populations...I remember that often when I surprised a Peuhl shepherd with his flock in a classified forest, not only did I give him a fine and make him take his animals to the pound, but I forced him to eat leaves on the spot to*

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<sup>43</sup> A double wrong; even if local people were responsible for the degree of woodland destruction attributed to them, it is highly unlikely to have any regional climatic impact. It is, for example, listed among the “Forest myths” in FAO (1993)

*discourage him from trespassing again. But there was nothing we could do, they were always coming back so we hounded and persecuted them.*<sup>44</sup>"

Forest legislation has been little different in much of the rest of colonial Africa. With independence, some of the more deeply resented elements in the various forest codes were watered down but most of the new governments were happy to retain control over the woodlands of the new nation states. Today, under the forestry code of many countries, people are allowed to collect dead wood, graze livestock and collect fruits and other products in the natural woodlands but are not allowed to cut living trees, even on common lands, without a forestry permit. Moreover, these rights are only effective as long as the products remain non-commercial.<sup>45</sup> Once the product becomes commercial on anything beyond a minor scale, control of its exploitation passes to the forest service or some other arm of the state.

Researchers in the Kissidougou area of Guinea commenting on the strictness of the forestry code in the area said that:<sup>46</sup>

*Many aspects of local land use have been criminalized. Setting bush fires – whose timely application has been a central feature of villagers' land management – carried the death penalty in the 1970s! Formal fines and informal extortion by environmental services further tax an already cash-poor population. (p4)*

In addition to bearing heavily on the local people, such measures, as the researchers noted, open a wide range of opportunities for extortion and corruption, which are often fully taken advantage of by local forestry and government officials throughout the dry tropical woodland countries. Referring to the West African Sahel, another commentator has noted that:

*Laws are selectively applied as a function of the economic and social status of the individuals and groups to whom they are supposed to apply. Agents use their state sanctioned authority to extract benefits from rural populations. Bribes or gifts are often used to avoid being fined or having to follow forestry regulations.*<sup>47</sup>

In addition to being unjust, this can have fairly perverse results. Arbitrary fines for cutting trees act as a powerful deterrent to planting or cultivating them. Refusing people permission to manage woodlands as they see fit, can mean they are not managed at all. Preventing local people from setting fires in the way they deem most responsible can mean they are set irresponsibly. The following illustrates some of these impacts in Senegal:

*In the mid seventies, Senegal's Department of Forestry announced that the forest belonged to the state and began requiring villagers to obtain permits before cutting live trees. This policy had two visible negative effects: first, the villagers stopped planting trees which they had traditionally cultivated, since they would no longer be permitted to freely harvest them, secondly,*

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<sup>44</sup> Montagne et al (1994).

<sup>45</sup> Ribot (1995)

<sup>46</sup> Fairhead and Leach (1996)

<sup>47</sup> Ribot (1995b) p 47



*the villagers began setting forest fires in order to kill trees, since dead trees could legally be cut down.*<sup>48</sup>

Apart from such impacts, the insidious overall effect of much of this oppressive legislation is to confirm the widespread impression that local people are essentially lawless, ignorant and bent upon wanton destruction of the natural woodlands around them. This has allowed forestry services and donor agencies to believe that the failure of various initiatives to promote tree growing, for example, or disseminate improved cooking stoves in the rural areas, was a result of rural people's ignorance and fecklessness. It has preserved many projects from the critical scrutiny, which they needed.

### 3.2 The Kissidougou experience

The vegetation cover in the prefecture of Kissidougou in the Republic of Guinea is described as a forest-savanna mosaic. It is part of that broad band stretching from Senegal and Guinea in the west as far as Ethiopia and described as *woodland* in the map shown on page 17 in the *Estimating Woody Biomass in Sub-Saharan Africa*, MILLINGTON, A. C. et al (1994).

. The landscape consists of open expanses of grassy savanna interspersed with islands of forest, a kilometre or two in diameter, within which are found the 800 or so villages in the prefecture.

The conventional reading of the landscape has been that these forest islands are remnants of the forest, which once covered the area. The savanna is seen as the "derived" type, a product of the people's shifting cultivation and fire-setting practices. The belief that the area has been in the grip of rapid deforestation has been universal. It has been taught in primary and secondary schools and has formed the basis of official government and external donor policy towards the area.

The Guinea national forestry plan published in 1988, for example, states, "*The opinion, quasi-general, is that ...the areas north of Macenta, Gueckedou, Kissidougou will soon be no more than a vast poor savanna, the forest islands and gallery forests still present at risk of being rapidly destroyed (p24).*"<sup>49</sup> A report prepared for an integrated rural development programme for the Kissidougou area in 1991 stated that:

*The degree of degradation of nature, broadly attributable to annual bush fire at a large scale, is alarming...The primary forest of 30 m height, composed of humid species and wooded savanna, has totally disappeared in the prefecture of Kissidougou...it has given way to a very open savanna of elephant grass and a few stunted savanna trees which burn easily during the dry season (p28)*

On the assumption that all this was true, a research project was launched in the beginning of the 1990s to study the dynamics of the deforestation, taking place, and find out how the local people understood the process and responded to it technically and socially. Even the locally recruited research staff for the project accepted the conventional view that widespread deforestation was taking place and one member of the team had made it the basis of his philosophy dissertation.

<sup>48</sup> Ribot (1986).

<sup>49</sup> Fairhead and Leach (1996). Unless otherwise noted, all quotations in this section are from this source.

It soon became clear to the researchers that the conventional interpretation of what was happening in the landscape was seriously at variance with reality. They found that, rather than undergoing rapid deforestation, little change appeared to have taken place in the woodland cover in the previous eighty years. The following is a description of the area in 1914 found by the researchers:

*From Kissidougou to Gueckedou, all has been cut...the effects of this de-wooding are disastrous; one will soon see nothing more than entirely naked blocks of granite. A region, so fertile becomes a complete desert. Now there rests no more than a little belt of trees around each village and that is all. (p17)*

Exactly the same description was given in the late 1940s by the botanist responsible for Kissidougou's forest policy. He said that the vegetation cover consisted of "oases of equatorial vegetation in the middle of savannas burned by the sun and fire... all in regression." (p25)

Leaving aside the tragic tone, both quotations provide a reasonably accurate description of Kissidougou as the researchers found it at the beginning of the 1990s. Over the previous eighty years, there had been little change in the landscape. This discovery that the woodland cover, rather than being in rapid retreat, was apparently in a state of stable equilibrium put in question not only the basis of the research project but the whole official forestry and land-use approach being used in Kissidougou.

Following this new line of investigation, the researchers were able to locate a series of air photographs of five localities in Kissidougou taken in 1952, 1982 and 1989/92. Detailed comparisons were made between the photographs and ground truthing was carried out in five areas. The picture that emerged was not, of course, uniform. In some areas, the researchers found that the woodlands had disappeared completely and the land had been built over or was being used for intensive cultivation. But the overall results quite clearly showed that the areas of forest, rather than declining, were actually increasing, sometimes quite dramatically, as shown in Table 3.1

**Table 3.1: Increase in forest area in Kissidougou 1952-92**

<i>Locality</i>	<i>Area analysed (ha)</i>	<i>Forest area 1952 (ha)</i>	<i>Forest area 1981 (ha)</i>	<i>Forest area 1989/92 (ha)</i>	<i>Percentage increase 1952-92</i>
Moria	9,500	448	562	633	41
Sandaya	7,000	512	778	900	76
Fondambadou	3,525	698	654	1,064	52
Bamba	5,400	634	No data	1,411	123
Toly	4,550	708	No data	4,288	506

Source: Fairhead and Leach

This was completely at variance with the accepted view of what had been happening in Kissidougou but the evidence for the overall tendency of the woodlands to increase in area was incontrovertible. A review of the results by staff of Kissidougou's forestry and environmental staff commented:

*If we compare visually ...we can observe that numerous zones, which were visibly lightly wooded savannas in 1952 have today become savannas, dry*

*forest and even in some places young dense forests. Other land, which was covered in forest in 1952 has been cut, without doubt for cultivation. But in looking over the whole territory, we can easily see that the overall area of wooded zones in Kissidougou has certainly not diminished in an alarming fashion, but on the contrary one can believe that it has tended to increase over the last 40 years. (p60)*

The reality appears to be that the forest islands, far from being remnants of a vanished forest, have been created by local inhabitants. Long accused of destroying the original forest, especially by their use of fire, the local people have, in fact, shown a high degree of sophistication in their management of the landscape. The implications for woodland policy in the Kissidougou region are profound and far-reaching.

### 3.3 The dynamics of the “tiger bush” in Niger

Much of the natural woodland in Niger occurs in the form of strips or patches of vegetation interspersed with areas of hard, bare, impervious soil. The striped appearance of this landscape from the air has led to its nickname of “tiger bush.” One of the distinctive features of the strips of vegetation is the number of dead trees they contain.

It has long been believed that the tiger bush is a degraded form of savanna woodland caused by the fact that rainwater, instead of penetrating into the ground, runs to waste from the impermeable soil of the bare strips between the vegetation. A variety of projects has attempted to restore the woodland to its presumed full productive potential by improving the water-capturing capacity of these strips.

One approach is to create “micro-catchments” in the form of shallow circular or half-moon-shaped depressions a couple of meters across which funnel the water towards the centre where a tree is planted. Other measures include building small dams across gullies and streambeds, or constructing low bunds of earth across slopes to hold back the flow of water during the rainy season and allow it to soak into the ground. The work is arduous and expensive and the success rate and sustainability of most of these projects has been low.

Work carried out by ecologists near the village of Tientiergou, about 50 km southwest of Niamey in Niger, in connection with the World Bank Household Energy Project, goes a considerably way to explain these failures at a technical level. The researchers, from the French research organisation ORSTOM, found that the ecological dynamics of the tiger bush are much more complex than previously supposed and that the rainwater flowing down the slopes of the barren areas interacts with the patches of vegetation in a previously unsuspected way.<sup>50</sup>

At the upstream edge of the vegetation strip, the water-flow causes an accumulation of grass seeds and vegetable matter, which promotes intense termite activity. This greatly increases the permeability of the ground and facilitates the infiltration of some of the rainwater. The remainder flows into the already-growing area where the permeability of the ground is high because of the existing vegetation. The water therefore infiltrates the ground and is taken up by the vegetation roots. Under normal conditions, little of the water flowing into the patch of vegetation escapes at the down-slope edge.

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<sup>50</sup> Galle et al (1997)

At the upstream edge, because of the infiltration of water and the accumulation of seeds and organic matter, a fringe of pioneer grass species colonises a new strip of the impermeable area, a few tens of centimetres wide, each rainy season. The overall patch of vegetation therefore creeps gradually up the slope year by year.

At the centre of the patch of vegetation, where the water infiltration is greatest, the potential for tree growth is at a maximum. The species found include *Combretum nigricans*, *Combretum glutinosum* and *Gardenia sokotensis*. After several decades of growth, such trees have reached maturity but, because of the gradual movement of the overall patch up the slope, they are now situated downstream from the zone of maximum water infiltration. Their water needs are no longer fully met and they slowly die. As the vegetation strip slowly moves up the slope, it leaves the dead trees and scattered patches of *Boscia senegalensis*, a highly drought-resistant bush, behind.

The tiger bush thus represents, in effect, the climax vegetation for the area. The total quantity of biomass is at a maximum, determined by the availability of rainfall, and any attempt to increase the infiltration of water in other areas will lead to a reduction in its availability in the strips of vegetation.

Grazing plays a vital part in the ecology of the system. In their natural state, these areas of tiger bush support a variety of wild herbivores. Over the centuries, domesticated livestock has gradually replaced the wild herbivores. It is these grazing animals, whether wild or domesticated, which hold the key to the full ecological dynamics of the tiger brush.

The new growth in the grassy fringe of the vegetation strip is an attractive source of fodder for these herbivores. When it is grazed, its ability to impede the flow of rainwater runoff is reduced and sufficient water penetrates to the inside of the vegetation patch to enable the tree species to develop and mature. This indicates that if grazing were to be completely suppressed, the grass fringe would become much larger and absorb a greater proportion of the rainwater runoff, leaving the trees in the vegetated patch without sufficient water for survival.

Experiments at Tientiergou have confirmed this and shown that trial areas that were completely closed against all grazing have become covered with grass species. Although it remains to be confirmed by long-term trials, this suggests that the complete suppression of grazing would destroy the natural dynamics of the tiger bush and result in the development of an entirely grass or grass and bush savanna.

These findings also strongly suggest that the practice of building check dams, half-moon mini-catchments and other anti-runoff measures are likely to be counter-productive. One of the ORSTOM trials showed that building an anti-runoff bund upstream from a vegetation patch caused it die. Given the cost of such anti-runoff measures and the resistance of the local population to carrying them out except when paid to do so, it is a consoling finding.

There is also a longer term dynamic in the ecology of the tiger bush because of periodic climatic fluctuations. In the severe drought years of 1984-85, for example, many trees died for lack of water. The grazing pressure on the remaining vegetated areas was consequently increased so that they were reduced in size and their overall water-absorption capacity was reduced. With the return of higher rainfall, as has happened in recent years, the vegetation is no longer able to absorb all the rainfall and the runoff from the whole area is increased. As a result, there are much higher water levels in the lowland areas, with flooding, and in some cases drowning, of their tree formations.

These initial effects of the increased rainfall are, however, gradually diminished as growth in the tiger bush is stimulated. This reduces the runoff to the lower areas and the previous condition is gradually restored. There is, in fact, no natural equilibrium condition for the tiger bush but rather a quite dynamic ecology on which longer term oscillations are superimposed. The attempt to create, or restore, an imagined stable woodland coverage through the construction of micro-catchments and water-retaining structures in such an area is foredoomed to failure.

### **3.4 A need for caution**

There now seems little room for doubt that serious misreading of the processes shaping the local landscape has taken place in the case of the tiger bush in Niger and the forest-savanna mosaic in Guinea. The result, in both cases, has been a range of inappropriate and counter-productive legislation and interventions by governments and donor agencies.

Meticulous and open-minded local research has revealed the fallacies in the conventional views in these two areas. In the absence of similar research in other areas, it is not possible to generalise the findings. There are, nevertheless, a variety of hints, suggestions, indications and anecdotes, which suggest that, in many, if not the majority of cases, the perception of destructive mismanagement of woodland resources by local people are exaggerated, if not downright wrong.

There is always a strong tendency for investigators to find what they expect. Project appraisal missions have neither the time nor the authority to carry out a radical appraisal of their terms of reference and the framework within which projects have been designed and agreed. Rural dwellers, out of politeness, apprehension, self-interest, or fear of later retribution, tend to provide the answers they feel external investigators want to hear. Local officials in forestry and environmental services are, quite reasonably, hesitant about contradicting the preconceived views of visiting donor agency representatives. No local problem means no local project.

It is also becoming increasingly clear that the widespread impression of a deranged rural population who cannot be let out of the protective custody of government officials and foreign experts is unfair. While people on the edge of survival may be forced to take short-term measures when under pressure, this does not mean they are not capable of seeing beyond the immediate present, especially at the community level. There are strong local traditions of looking to the long-term future in many areas; the creation and preservation of acacia albida parks is just one obvious case in point.

The most important requirement when interventions are being planned in the forestry and woodfuel sector is that the investigative approach is open-minded. Projects are unlikely to succeed if the diagnosis of the problems they are addressing is wrong or badly exaggerated. The possibility that the conventional wisdom is incorrect needs to be constantly borne in mind and tested against the available evidence.



# 4

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## The Emergence of the “Woodfuel Crisis”

The belief that the developing countries were facing a major “woodfuel crisis” emerged in the mid-1970s. It was given particular resonance by the fact that the industrial world, at that time, was suffering from the effects of the oil price rises imposed in the wake of the 1973 Middle East war.

There had long been concerns in forestry circles about the depletion of the tropical forests and the new perception of an emerging woodfuel crisis was quickly and widely accepted. It gave rise to a large array of programmes design to counter the problem of depleting woodfuel resources and the dire environmental consequences this was expected to bring.

### 4.1 Perceptions of a woodfuel “crisis”

The environmental writer, Erik Eckholm, coined the expression “the other energy crisis.”<sup>51</sup> In travelling round the developing world, he saw widespread deforestation taking place and linked it with the almost universal use of woodfuel. He wrote:

*The inexorable growth in the demand for firewood calls for tree-planting efforts on a scale more massive than most bureaucrats have ever even contemplated, much less planned for. The suicidal deforestation of Africa, Asia and Latin America must somehow be slowed and reversed. Deteriorating ecological systems have a logic of their own; the damage often builds quietly and unseen for many years, until one day the system falls apart with lethal vengeance. Ask anyone who lived in Oklahoma in 1934, or Chad in 1975.<sup>52</sup>*

His graphically expressed ideas were compelling and took firm hold. A contemporary observer, writing about the global energy question, was convinced by the Eckholm analysis and wrote that “wood, over a rapidly increasing area of the world’s surface, is likely to be the first major energy source to ‘run out.’<sup>53</sup>

A report prepared for CILSS and the Club du Sahel in 1978<sup>54</sup> fully concurred. It said “...every simulation model leads to the conclusion that, in the absence of vigorous action

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<sup>51</sup> Eckholm (1975)

<sup>52</sup> Eckholm (1976) p113

<sup>53</sup> Foley (1976).

<sup>54</sup> CILSS/Club du Sahel (1978)

now, much of the Sahel region will have become a desert by the year 2000." It called for massive reforestation programmes.

*The present afforestation programmes are utterly inadequate by comparison with the size of foreseeable needs. The situation calls for 150,000 hectares of new forest plantations annually i.e. 50 times more than at present. ...Action must be prompt. Time is of the essence. It should not be wasted on "analysing the situation" as there is a risk that in the meantime the situation will have so deteriorated that it can no longer be remedied."*

The publication by FAO in 1981 of a map of the woodfuel situation in the developing world provided dramatic and authoritative underpinning to the prevailing views of an impending crisis. This was followed in 1983 by a report<sup>55</sup> giving detailed figures and analytic backing for the results shown on the map. The analysis compared estimates of woodfuel consumption in different areas with the estimated sustainable yield of the locally available woodlands<sup>56</sup> and found that nearly 100 million people were already living in acute woodfuel scarcity in which "... over-cutting of the woody vegetation, or what remains of it, and where possible the use of agricultural residues, did not suffice to meet minimum requirements."

A further billion people were in a "deficit" situation in which they were only able to meet their minimum woodfuel needs by over cutting existing resources. Projecting the figures forward, the study showed a massive increase in these figures, with 2.4 billion people living in acute woodfuel scarcity by the year 2000. The detailed breakdown given in the study is shown in Table 4.1.

**Table 4.1: Woodfuel scarcity and deficits in 1980 and 2000**

Region	1980		1980		Prospective deficit		2000	
	Acute scarcity		Deficit		Prospective deficit		Acute scarcity or deficit	
	Total pop*	Rural pop	Total pop	Rural pop	Total pop	Rural pop	Total pop	Rural pop
Africa	55	49	146	131	112	102	535	464
Near East and North Africa	31	29	832	710	161	148	1,671	1,434
Asia/Pacific	31	29	832	710	161	148	1,671	1,434
Latin America	26	18	201	143	50	30	512	342
Total	112	96	1,283	1,052	323	280	2,986	2,398

\* The total population figure is for the estimated number of urban and rural dwellers relying on woodfuel

The study talked of an existing serious situation escalating into a "gigantic problem" by the year 2000 in which in "... a growing number of situations woodfuel will probably no

<sup>55</sup> de Montalembert and Clement (1983)

<sup>56</sup> The figures used were:

Wooded savanna	1 m <sup>3</sup> /ha/yr = 0.67 t/ha/yr <sup>56</sup>
Savanna with trees	0.5 m <sup>3</sup> /ha/yr = 0.33 t/ha/yr
Shrub formations	0.1 m <sup>3</sup> /ha/yr = 0.07 t/ha/yr



*longer play more than a marginal role unless actions are rapidly intensified on a scale consonant with the size of the problem."* It also suggests that rural people would not be able to handle the problem on their own.

*What emerges particularly from this analysis is the magnitude of the task that has to be carried out in order to resolve the energy problem of the populations dependent on woodfuel, whose supplies will henceforth have to be ensured by deliberate action and no longer left to the people to gather as and where they can..." (p24)*

The authority and outreach capacity of FAO ensured that this analysis was widely disseminated and it became, in effect, the accepted wisdom on the "woodfuel crisis." A wide range of studies and commentaries published around that time all accepted the FAO thesis.<sup>57</sup> A paper by two World Bank economists published in 1984,<sup>58</sup> noted the uncertainties in the woodfuel supply and consumption data for the Sahel but said the "...underlying trends are not in dispute..." It went on to suggest that in the Sahel as a whole, the excess of consumption of woodfuel over new growth in 1980 was about 30 percent and likely to increase to 127 percent by the year 2000.

The same paper quoted an estimated excess of consumption over new growth of 193 percent in Niger in 1980, implying the more or less complete disappearance of the country's wood supplies long before the year 2000. The paper suggested a three-pronged programme of substitution of commercial fuels, mainly kerosene but also LPG and electricity, for woodfuel; conservation through improved cooking stoves and other methods; and investment in forestry and agro-forestry.

Another World Bank paper dealing with woodfuel supplies in Ethiopia published around the same time<sup>59</sup> pointed to a "...gap between the supply and demand of firewood..." and called for "...a mammoth effort of afforestation." Its vision of the consequences of the accelerating crisis as woodfuel supplies declined and people turned to the use of dung for fuel was almost apocalyptic.

*Arable land and grazing land is bare most of the year. Soil erosion is dramatic and nutrient rich topsoil is much depleted. Dung and dry matter production have fallen to a small proportion of previous levels. The impact of dry periods is devastating as the ecosystem buffering capacity is negligible. Survival is, at best, marginal...There is a total collapse in organic matter production, usually catalyzed by dry periods which were previously tolerable. Peasants abandon their land in search of food and other subsistence needs. Starvation is prevalent...*

Given the strength and authority of the prevailing consensus, it is not surprising that large-scale development assistance efforts were devoted to efforts to counteract the depletion of natural woodlands and combat the dangers of desertification. There was no lack of commitment or ingenuity, as the following commentary on activities in the Sahel makes clear.

<sup>57</sup> See for example Eckholm, Foley, Barnard and Timberlake (1984)

<sup>58</sup> Anderson and Fishwick (1984)

<sup>59</sup> Newcombe (1984) p3

*It would not be far from the truth to state that virtually every conceivable strategy has been proposed by someone at one time or another over the past decade – each strategy with its proponents, many of them with funding for at least a pilot effort. Fortunately, some of the more questionable and costly of these schemes have been avoided, the Sahel green belt for example, an idea that made neither technical, economic nor social sense, however compelling the visual image of a line of trees stopping the 'advancing desert'.<sup>60</sup>*

In practice, the majority of these interventions failed to make any significant impact; some were complete failures; and some were downright counterproductive. Fortunately, the woodfuel crisis also failed to materialise in anything resembling its predicted dimensions. These two outcomes were deeply intertwined.

## **4.2 Efforts to avert the “woodfuel crisis”**

The efforts to avert the “woodfuel crisis” can be divided into four broad approaches: economising on woodfuel consumption by promoting more energy-efficient cooking stoves and improved charcoal making; encouraging the use of substitutes for woodfuel; increased production of woodfuel in forest plantations and the promotion of tree-growing by individual farmers and communities; and the development of legal and fiscal measures to control woodfuel harvesting.

The following brief accounts of activities in these areas show the extent to which they depended on the “woodfuel crisis” consensus for their initial rationale and support. If, indeed, the woodfuel crisis had turned out to be as severe as predicted, it is easy to see that many of these programmes might have been seen as locally relevant and been enthusiastically adopted. In the event, the general lack of success of most programmes can be related to the fact that the “woodfuel crisis” was generally exaggerated or misinterpreted.

### **4.2.1 More efficient cooking stoves**

The improved cooking stove programmes of the late 1970s and early 1980s were all intended to prevent deforestation. It was believed that if woodfuel consumption could be reduced, then so would deforestation. A commentary on Senegal, for example, stated that if every Senegalese family cooked on an improved stove there would be a 50-60 percent saving in wood and the entire forestry deficit of the country would be absorbed.<sup>61</sup> A call for action on the promotion of more efficient cooking stoves stated, “*At the moment, 10,000 stoves have been built to solve the problems of deforestation, we should have 100 million stoves within 20 years.*”<sup>62</sup>

A wide variety of improved stove programmes was launched in response to such perceptions of their potential role in saving forests. They included the promotion of homemade mud stoves in the rural areas and metal or ceramic types, which were sold commercially, in the urban areas. Some early commentators, however, questioned the

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<sup>60</sup> Taylor and Soumaré (1983)

<sup>61</sup> Cap et al (1980)

<sup>62</sup> Christaaens (1982).

rationale of stove design, asking whether energy efficiency was really such a priority for stove users. A particularly perceptive observation was the following:

*One frequently hears questions like 'If you had a stove that used only half the fuel you currently use, would you cook on it?' This is not the real question. The question might more accurately be 'If you had a stove that used less fuel would you be willing to cut your wood into 8-inch lengths, control the damper and clean the flue?'*<sup>63</sup>

In the rural areas, where people do not pay for the woodfuel they use, it was evident that stoves would have to have a zero cash cost. Various types of home-constructed stoves were developed such as the Ban-ak-Suuf in Senegal, which was formed from a mixture of clay and sand. These required a considerable amount of labour on the part of the householder and imposed significant restrictions on the type and size of fuel, which could be used. It soon became evident that they offered little, if any, improvement over what people were able to manage for themselves using the traditional three-stone fire. The adoption rate of these stoves was low and in households, which constructed one, they rapidly deteriorated and were not rebuilt. Results with rural stove programmes elsewhere were similar and rural stove promotion was largely abandoned.

The urban areas where people pay for woodfuel, however, were a different story. Here people pay for their woodfuel and a more efficient stove enables them to save money on their fuel bills. A variety of firewood that is more energy-efficient and charcoal stoves was developed. They were usually adapted from designs already in use and provided improved heat-transfer to the cooking pot and additional insulation to reduce heat losses.

Substantial numbers of these new energy-saving stoves are already in use in a variety of countries and the numbers being sold continue to rise. The Kenya programme is well known for the successful promotion of the improved *jiko*, or charcoal stove, in Nairobi. In Ethiopia, the Lakech charcoal stove, which has a ceramic liner to reduce heat loss similar to that used in Kenya, allows people to save about 25 percent of the fuel used in a traditional stove. A report in 1994 found that since its launch in 1991, over 65,000 of the new stoves had been sold in Addis Ababa<sup>64</sup> and the programme was entirely in the hands of private sector producers and sellers.

In time, it is possible that such new and more energy-efficient stoves will completely supersede the traditional types in some urban areas. The result will be a higher average cooking efficiency and a benefit, in lower unit energy costs, to users. Any connection between woodland depletion and stove use is, however, at best, tenuous. There are so many variables affecting woodfuel use in any particular area that pinning down the effect of a certain number of improved stoves is virtually impossible without impracticably detailed surveys over a considerable period. Most deforestation, in any case, is a result of clearing land for agriculture rather than woodfuel harvesting.

Other effects than those intended are also possible. Improved charcoal stoves, for example, may encourage greater use of charcoal and slow the shift to alternative fuels. To date, no change in woodfuel consumption trends, which can be attributed to improved cooking stoves, has been detected even in urban areas where they are widely in use.

<sup>63</sup> Hoskins (1979)

<sup>64</sup> World Bank (1995) p 68

Equally, the dire predictions of woodfuel scarcities and soaring prices have failed to appear in areas where they have not been adopted.

It is now clear that the future of improved cooking stove programmes lies in the provision of benefits to individual families. In addition to increasing energy-efficiency, stove designers are focusing on the overall attractiveness of the stove, taking into account factors such as greater safety and quicker cooking times. In the near term, improved energy efficiency allows users to reduce their expenditure on woodfuel; in the longer term, it provides a cushion against prices if they start to rise. The paradoxical long-term effect of the more successful programmes may be in prolonging and enhancing the role of woodfuel in the domestic fuel market.

#### 4.2.2 Improved charcoal-making

In the traditional charcoal kiln, trees are cut, arranged in a pile, covered with earth and subjected to more or less controlled burning with a limited supply of air. The heat drives off the volatile components of the wood leaving the charcoal as residue.

The belief that charcoal making is a highly inefficient use of wood resources, has led to widespread condemnation of its use as a domestic fuel. Even more than fuelwood harvesting, it is seen as an agent of deforestation and depletion of woodland resources. Its use has been banned, for example, in The Gambia. Before such a sweeping conclusion about the evils of charcoal making is drawn, however, it is useful to look at the whole system by which charcoal is made and used. The case for attempting to ban or discourage its use is not as obvious as might appear at first sight.

One reason is that there is often confusion over what exactly is meant by the efficiency of charcoal making. Two measures are used. One is the yield by weight which is the weight of charcoal produced compared with the weight of the original wood. The energy-efficiency is the final energy in the charcoal as a proportion of the original energy in the wood. Because charcoal has about twice the energy content per unit weight of wood, the energy efficiency is roughly twice the yield by weight.

Yields by weight depend greatly on the type of kiln used. Professional charcoal-makers using large kilns typically achieve a yield of 20-25 percent or more, which is an energy-efficiency of 40-50 percent. Small kilns made by farmers or occasional makers may have yields as low as 10 percent by weight, which is an energy efficiency of about 20 percent, but such small manufacturers usually, only supply a small proportion of overall consumption in countries where charcoal is a major domestic fuel.

There are additional compensating advantages in the use of charcoal. It does not rot and can be made when wood is available and stored indefinitely without significant loss. The traditional charcoal stove tends to be up to three times as efficient as the three stone fire and up to twice as efficient as some types of improved wood stoves. Because charcoal can sustain combustion even in small amounts, it can be used more economically than wood for small cooking tasks. It is also easier to quench and reuse than wood. An FAO paper comments:

*When the relative efficiency of wood to charcoal conversion and the burning efficiency of wood and charcoal fires are compared, the practice has much to commend it...Calculation shows that carbonising large diameter wood and burning the charcoal is about twice as efficient thermal as burning the wood direct in an open cooking fire. Furthermore, without*

*axes, saws and wedges, large diameter wood is unused and may rot before it can be burned.*<sup>65</sup>

Taking the whole system from tree to domestic cooking pot, it can be seen that the overall efficiency of charcoal use may be as high as that of fuelwood, if not higher. It is certainly an exaggeration to assume, as is done in some studies, that the figure for charcoal consumption should be multiplied by a factor of four or five to obtain the amount of wood used in its manufacture. The exact figure in any particular case can only be established by a review of the whole sequence, as it actually occurs, from woodcutting through to final consumption in the domestic fire or stove.

Attempts to ban or control charcoal making can also have perverse results. Private production of charcoal was banned in Ethiopia in an attempt to prevent depletion of forest resources. This did not stop charcoal-making but ensured that it was carried out by small informal producers in a far less efficient way than if it were being done by professionals using large kilns.<sup>66</sup> One of the results of the charcoal ban in The Gambia is that woodfuel harvesters leave large branches, which would otherwise be made into charcoal, to rot in the forest because of the labour involved in cutting and transporting them.

A ban on charcoal making was also introduced in Malawi. The results were equally counter-productive:

*The charcoal ban and bans on brick burning were put in place to save deforestation. This study shows how wrong this assumption was. The ban made charcoal production illegal but it did not stop it. It increased the price of the fuel by making it more costly to produce and get to market, for authorities had to be bypassed, usually with bribes. It also means that the forestry department has no control over where charcoal is made, it cannot collect stumpage fees if it is made in forest reserves, nor can it advise or train charcoal producers on woodland management and charcoal production.*<sup>67</sup>

Sporadic attempts to promote improved traditional charcoal-making techniques in the dry tropical woodland areas have been made by developing country forestry services over the past hundred years. Most have attempted to persuade traditional charcoal-makers to use steel kilns, which were rolled between manufacturing sites in the woodlands. Some promising experiments were carried with steel kilns in Uganda in the 1960s in which charcoal making was linked with overall forest management but ended with the access to power of Idi Amin.<sup>68</sup> Although all these programmes promoted kilns with up to twice the efficiency of the traditional type, none appears to have had any significant enduring impact.

The Casamance kiln, introduced to Senegal during the 1970s, is an improved version of the traditional clay kiln. It essentially relies on more careful cutting and stacking of the wood and has been found to provide a higher yield of charcoal per given volume of wood.

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<sup>65</sup> FAO (1983) p121

<sup>66</sup> World Bank (1995) p71

<sup>67</sup> Openshaw (1997)

<sup>68</sup> Earl (1973)

It has, reportedly, come into use in some charcoaling areas but has not been widely adopted.

A major weakness of the great majority of programmes to improve the efficiency of charcoal-making is that, driven by the perceived need to save the forests, they have focused almost exclusively on energy efficiency, reasoning that higher efficiencies will lead to lower wood consumption and lower rates of deforestation. Energy efficiency as such, however, is of little significance to traditional charcoal makers immersed in the financial practicalities of their trade.

As long as wood is available, their major consideration is the amount of time and effort they have to put into making the kiln. A balance has to be sought between the extra labour involved in cutting and stacking wood for the Casamance kiln as opposed to increasing production by making the traditional kiln larger or constructing an additional one.

Where the cash cost of the wood is zero and its availability is not the limiting factor on charcoal making, the only type of new kilns likely to be adopted are those which lessen the labour burden on the charcoal-making gang without incurring any cash outlays. If circumstances can be identified in which charcoal making is limited by wood-availability, or charcoal-makers are compelled to pay for the wood they use, efficiency would become a more important issue and improved charcoal-making would come into consideration. These conditions, so far, appear to be rare, if they even occur, in most of the dry tropical woodland areas being considered in this study.

#### 4.2.3 *Substitution of alternative fuels for woodfuel*

Cooking with woodfuels is messy, awkward, unpleasant and, especially when carried out in a small enclosed kitchen, damaging to health. As families become better off, they tend to make a voluntary shift to alternative cooking fuels such as kerosene, LPG and electricity. At first, the use of these alternatives may only be for light meals, making tea or warming food, with woodfuels continuing as the main cooking fuel. As families become more prosperous, the use of the alternatives gradually increases. An Indian commentator referring to this remarked:

*It is a moot point whether the poorer strata will ever consider wood-burning stoves (even costlier and improved ones!) as an elevation in their standard of life when they are aware that of the fact that the more affluent sections of their society always prefer cleaner and more convenient cooking fuels to wood. The poor know that there is a hierarchy of cooking fuels and the view changes from fuelwood to charcoal to kerosene to electricity or gas as steps in the improvement of the quality of their life.<sup>69</sup>*

A number of countries have attempted to accelerate this shift to alternative fuels in order to reduce woodfuel consumption and thereby lower their rate of deforestation. Senegal was among the earliest with its *butanisation*<sup>70</sup> programme launched in the early 1970s. At the time, the national oil refinery was producing a surplus of butane gas, which was being flared off because there was no market for it. There were also major worries that the

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<sup>69</sup> Reddy (1983)

<sup>70</sup> Although not necessarily strictly correct technically, the terms *butane* in French and LPG in English tend to be used interchangeably.

consumption of charcoal in the capital city Dakar was leading to large-scale desertification in the country.

The *butanisation* programme was actually based on the erroneous assumption that butane had ten times the calorific value of charcoal;<sup>71</sup> in fact, it has about 1.5 times the value. A determined promotional programme involving heavy price subsidies and widespread publicity was launched in 1974. It was initially calculated that after five years, sales of butane would have reached 10,000 tonnes per year, displacing 100,000 tonnes of charcoal.

By the early 1980s, the country's consumption of butane had risen to about 11,000 tonnes. This was about twice the output of the refinery, with the balance being imported, at a time when petroleum imports were a major burden on the country. The overall subsidy on LPG was around 70 percent of the retail selling price of a 12.5 kg bottle and 85 percent of that on a 2.7 kg bottle<sup>72</sup> and amounted to US\$3.5 million per year. Most of the LPG was being used by richer families who, in the normal evolution of urban fuel demand patterns, might have been expected to be doing so in any case. At that stage, there was no detectable impact on charcoal consumption.

Consumption of LPG, nevertheless, continued to grow through the 1980s and was greatly stimulated when the government reduced prices by 40 percent in 1985. In 1994, when the currency was devalued by 110 percent, the government protected LPG consumers by only allowing an increase of 30 percent in the controlled price. A World Bank study reports that LPG use reached 50,000 tonnes in 1994, displacing 90,000 tonnes of charcoal consumption.<sup>73</sup>

The European Union signed an agreement with CILSS, in 1988, for a regional programme to promote butane gas in the Sahel as a substitute fuel for firewood and charcoal in 1988. Funding under the programme was for publicity to promote the use of LPG as a cooking fuel, subsidies for the production of LPG stoves, training of local technicians in the manufacture of LPG stove components, and the purchase of trucks for the transport of LPG. For a variety of reasons, the programme was not successful and was formally discontinued in 1995.

In Niger, the World Bank's Household Energy Project included a demand component, the aim of which was to promote the use of kerosene as a cooking fuel. Following careful investigation and discussions with panels of consumers, it was found that a substantial number of middle and upper income families were prepared to consider using kerosene as a cooking fuel. A special kerosene stove, based on an Indonesian design, was developed for Niger and a local manufacturer undertook production with the support of a subsidy from the project. Erratic supplies of kerosene, and a large price increase because of the devaluation of the currency badly undermined the programme and its impact was slight.

Programmes to promote substitutes for woodfuel can thus be seen to raise two major questions. The first is whether it makes sense to subsidise better-off woodfuel users to accelerate the shift from woodfuels, which they are likely to make in any event. In most cases, this is unlikely to be justifiable.

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<sup>71</sup> See for example République du Senegal (1972) and Steedman (1979)

<sup>72</sup> World Bank Senegal (1983) p28.

<sup>73</sup> World Bank (1997)

The second question is whether there are significant wider considerations such as reduced deforestation or other benefits, which might justify the use of these subsidies. Where woodfuel resources are abundant, and future supplies are not problematic, there is clearly little point in subsidising better-off consumers to switch away from woodfuel. Equally, it makes little sense to try to reduce deforestation by means of subsidies for alternative fuels if woodfuel harvesting is not the main cause of deforestation. Both questions need to be given careful consideration before any programme to promote the use of conventional fuel substitutes for woodfuel is undertaken.

#### 4.2.4 *Forestry plantations*

There is a long tradition of forest services creating plantations in the vicinity of major cities in the developing world. Mostly, these were intended to produce commercial timber for construction or other purposes, with thinning yielded building poles and woodfuel. When the plantation was harvested, branches and smaller wood, the “lops and tops,” were available as firewood for sale or to be given away.

Some plantations were explicitly intended to produce woodfuel. A major initiative of this type is the Blantyre City Fuelwood Project in Malawi. This was carried out in response to an analysis in 1983, which predicted that Blantyre would need 60,000 ha of plantations to meet its woodfuel needs. A project was launched on the basis of this diagnosis with an initial target of planting 10,000 ha of fast-growing trees, mainly *eucalyptus camaldulensis*.

Around half this total was actually achieved by the project target date of 1993. The projected increases in prices and urban woodfuel consumption, however, failed to materialise and low-cost wood from natural woodlands and other sources has remained freely available. Wood production costs were greatly in excess of the market price and sales from the plantation were only possible at heavily subsidised rates. By the mid-1990s, the hoped-for financial viability of the project was still a distant prospect.

None of this should be surprising. The costs of establishing and maintaining a plantation mean that the wood is inevitably much more expensive than that obtained from natural woodlands and can only be sold if it is heavily subsidised. Fuelwood plantations cannot be financially viable as long as large supplies of woodfuel from cheaper sources remain readily available to dealers and consumers. This lack of financial viability will continue until the natural woodland resources have been heavily depleted or because woodfuel harvesters can no longer gain access to them. Even then, forest plantations still have to compete with wood grown by farmers or produced from managed woodlands.

Forest service plantations have never been a particularly convincing large-scale supply source for woodfuel and their impact has generally been extremely limited. Their future prospects as significant suppliers of woodfuel do not look any more promising.

#### 4.2.5 *Farm and community forestry*

Spurred by fears of the “woodfuel crisis” a vast number of programmes to promote tree growing by individual farmers or community groups of various types were launched in the late 1970s and early 1980s. Success was mixed.

Community forestry showed the highest rates of failure. Many of the reasons, especially in the early projects, were technical. Poor choice of tree species was a common cause of project failure in the dry-land areas. Introduced species such as eucalyptus were ill



adapted to the harsh and variable conditions in which they were planted; yields were poor and many community woodlots failed completely.

Social problems, especially those arising from disputes over the fair division of work and rewards, also undermined many programmes. The simple notion of a village woodlot, from which village people would agreeably draw their woodfuel needs, proved to be much more complex and difficult to realise in practice. By the mid 1980s, the community forestry approach had been largely abandoned.

Farm forestry, as it was widely known, had much greater success in some countries, none more so than in India. According to government figures, farmers planted over 8.5 billion trees, a high proportion of them eucalyptus, during the period 1981-88. However, these were not for woodfuel; *"The main reason was the hope of good profits from the sale of timber, poles and pulpwood – but not from lower-priced firewood."*<sup>74</sup> Many were planted in irrigated plantations instead of the less profitable cotton or other crops, which had been grown previously.

The financial returns were substantial and the programmes demonstrated that when it is profitable, farmers are happy to grow large numbers trees. Nevertheless, by the late 1980s, wood prices were falling and many farmers were harvesting their trees prematurely or uprooting them. Fuelwood production was not a significant factor in the programme since prices were rarely sufficient to cover growing costs. Some critics even argued that the plantations displaced local bushes and trees and actually reduced the availability of woodfuel.

No such farm forestry success stories, however qualified, are reported from the dry-land tropical areas of Africa. The majority of programmes to promote tree growing for woodfuel by farmers were failures. Much has, rightly, been made of the poor design of and inappropriate choice of species especially in early programmes. Crucial questions of land and tree-ownership were not addressed and people were expected to invest time and work in growing trees, which they would not own. The role of women was not understood or explored. The level of mistrust between forest services and local people was not fully taken into account.

The even simpler proposition that people felt there was no real need to plant trees for woodfuel was surprisingly rarely considered. Tree growing in arid climates can be an arduous task; seedlings have to be planted and watered; they have to be guarded from livestock; they produce no useable return for five to ten years. Local people have, nevertheless, shown themselves capable of going through this with fruit and other valuable trees all over the dryland tropics.

Their refusal to grow tree for woodfuel need not be attributed to peasant ignorance or short sightedness. With substantial quantities of useable biomass readily available around them, it seems reasonable to suppose that most families felt that growing trees for woodfuel was just not worth the trouble. In practice, this was eventually accepted in many programmes and the emphasis was shifted from woodfuel to "multi-purpose" species.

There is, nevertheless, evidence from a number of countries in the developing world that under certain conditions, farmers will grow trees for woodfuel. A large World Bank

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<sup>74</sup> Leach (1992)

project in Pakistan,<sup>75</sup> for example, carried out a detailed woodfuel supply and consumption survey for the whole country in the early 1990s. A large “gap” that appeared in the supply statistics was closed by the discovery that on-farm woodfuel production supplies a substantial part of the national fuelwood demand.

In practice, the conditions under which growing trees for woodfuel can make sense to farmers begin to develop as population densities increase and previously common land come under private control.<sup>76</sup> The primary purpose of such tree growing tends to be for poles or timber, with only the residual branches and trimmings being sold as woodfuel. As the Pakistan experience shows, however, the available volumes of woodfuel can be extremely large once tree growing is adopted on a significant scale by farmers.

An absolutely essential precondition if farmers are to grow trees for woodfuel is that they have ownership of their land, or at least, secure usufruct rights which ensure they can freely cut and sell any trees they grow without reference to forest officers or other officials. Even then, they will not invest time or resources in producing woodfuel if copious and cheaper suppliers are available from freely accessible natural woodlands.

#### *4.2.6 Legal and fiscal measures*

Most developing countries have woodfuel tax and control systems originally designed to regulate commercial woodfuel cutting. Woodfuel traders, for example, are usually obliged to obtain a cutting permit specifying the amount of wood, which can be taken and its location.

It is also common to impose taxes on the quantities of woodfuel transported into urban areas. Vehicles carrying fuelwood must pass through control-points on the way into urban areas and may be subject to random inspections by mobile patrols. This, in principle, provides a check on whether the woodfuel is being harvested from the area specified on the cutting permit and whether the cutting quota is being honoured.

Few control systems, however, function effectively. Control-points are frequently unmanned; even when they are; the poorly paid officials are frequently willing to wave woodfuel vehicles through in return for a small bribe. Taxation levels, moreover, are usually extremely low and many have not been changed for decades. They rarely amount to more than a few percent of the final selling price of the woodfuel. Even if they were collected efficiently, they provide no incentive to economise on woodfuel consumption or alter patterns of woodfuel harvesting or charcoal-making.

Because the tax component is so small, and largely evaded, the final price paid by woodfuel consumers simply reflects the costs of harvesting, transport, distribution and dealers' profits. This is far below the cost of growing trees on a plantation or producing them from an area of woodland deliberately managed by paid workers for sustainable woodfuel production. The woodfuel price, in other words, is well short of its “replacement” value using such methods.

Many projects launched in response to the “woodfuel crisis” therefore looked at ways of changing the taxation system to ensure that consumers paid the “true” economic price for their woodfuel. This would ensure that they used woodfuel more economically. The

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<sup>75</sup> Pakistan Household Energy Strategy Study (HESS)

<sup>76</sup> See description of Kakamega experience in Section 2.1.

collected revenues could also be used to provide start-up finance for woodfuel production schemes, which, since they were selling woodfuel into a market where it was priced at its replacement level, would eventually become self-sustaining.

The most commonly chosen approach was to set a "stumpage fee," or tax on woodfuel, which would bring its selling price up to its estimated replacement value. When this was based on woodfuel produced from plantations, or heavily managed natural woodlands, the required tax increases tended to be large; but in the "woodfuel crisis" context of the time there seemed to be little alternative. Despite much urging by donor agencies, however, developing country governments have been generally unenthusiastic about such measures. Their reluctance to impose large price increases on such a basic commodity as woodfuel is understandable and woodfuel prices have generally remained below their calculated replacement costs virtually everywhere in the developing world.

One exception is in areas where woodfuel prices have risen of their own accord to a level where farmers are spontaneously growing trees to supply the woodfuel market. In this case, woodfuel is priced, by definition, at its replacement value and any stumpage fee is redundant, though may be applied as a means of raising revenue. The other exception is where woodland resources remain abundant and natural regeneration takes care of the re-growth. In that case, the required stumpage fee is zero or close to it and no increase in existing taxation levels is required to bring woodfuel up to its replacement value.



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## An Exaggerated Problem

With the benefit of twenty years of hindsight, it is easy to see that the failure of the “woodfuel crisis” to materialise and the general lack of success of programmes designed to counter it had a common root cause. The “woodfuel crisis” was greatly exaggerated.

The outlines of a new woodfuel model, or paradigm, are now gradually emerging and beginning to provide a basis for a new and markedly more positive approach. Woodfuel supply, rather than presenting a fundamentally insoluble problem, is increasingly being seen as an opportunity for rural communities to earn sustainable cash income.

### 5.1 The fallacy of the “energy-gap” approach

Much of the fault, for the exaggerated perception of a “woodfuel crisis” lay in the widely used “energy gap” approach on which the majority of quantitative predictions of rapidly approaching woodfuel scarcity were based. This could be left to history were it not for the fact, that the overall effects of this method of analysis are both pernicious and enduring.

Implicitly or explicitly, the energy gap approach still underlies a great deal of present official and donor agency thinking about woodfuel issues and the way in which the dry tropical woodlands should be managed. If policy-making in relation to the dry tropical woodlands is to move forward, it is essential that the “energy-gap” approach be fully and finally abandoned.

#### 5.1.1 *Two examples of the “energy gap” analysis*

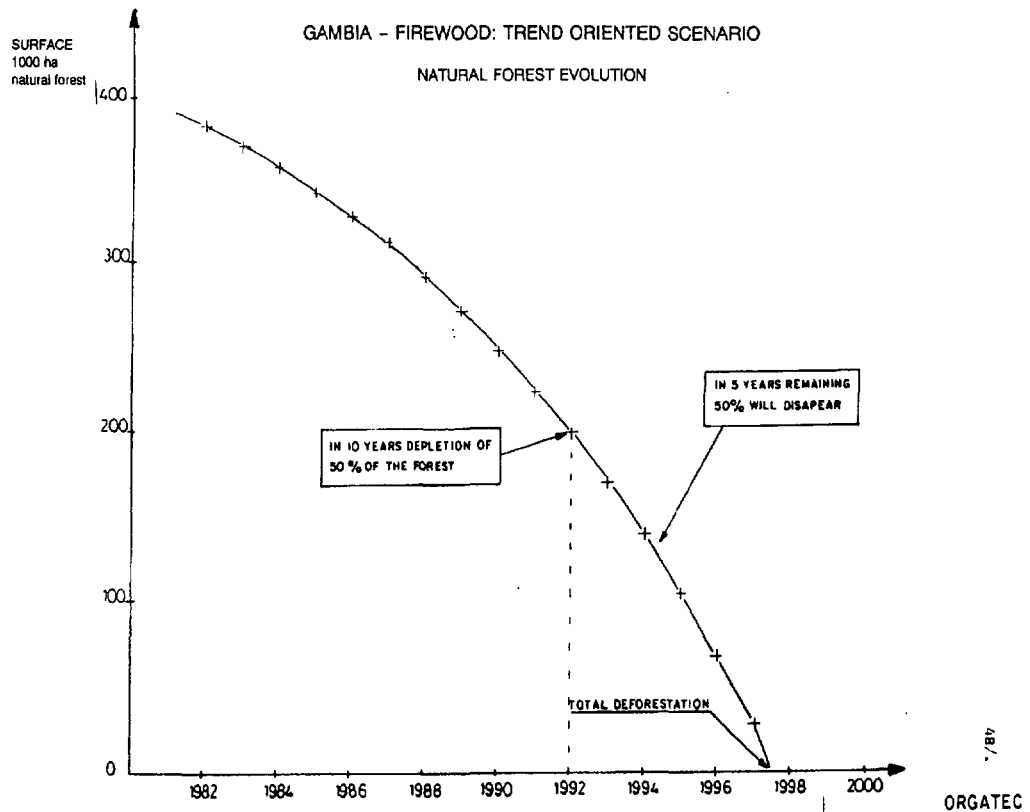
In the “energy gap” analysis, the woodfuel catchment area around a large city, or even a whole country, is considered. The annual increment in the growing stock in the area is then compared with the projected rate of woodfuel consumption, which is usually assumed to grow in line with the expected growth of population. The annual increment is assumed proportional to the growing stock.

As long as the projected woodfuel consumption is lower than the annual increment, it is assumed that the standing stock remains untouched and the woodfuel supply is sustainable. When the rate of consumption is in excess of the annual increment, this is known as a woodfuel “deficit”, and “mining” of the woodfuel stock is said to be taking place. Once “mining” begins, the stock figure is reduced, which it is assumed leads to a reduction in the annual increment which, in turn, leads to an increase in the deficit and the rate of stock depletion. When this is coupled with an annual increase in

consumption, the process accelerates and total depletion of woodland stocks rapidly occurs.

A study of The Gambia in 1983, for example, found a woodfuel “deficit” of 160,000 m<sup>3</sup> remarking that the “*present demand and supply situation is in balance only at the price of increasingly rapid use of forest capital... The final outcome of this scenario is the total disappearance of The Gambia forest within 15 years.”<sup>77</sup> This is illustrated in Figure 1*

**Figure 1: Trend-oriented scenario showing complete disappearance of Gambia forests**



One of the more bizarre results of such predictions was a project to clear natural woodlands in order to plant fast-growing exotic species to meet the anticipated woodfuel crisis. Wood production from the plantations turned out to be less than that from the natural woodlands they had replaced. Otherwise, little effective action was taken to implement the recommended increases in forestry production and fuel substitution. Yet, in spite of this, the dire predictions were not fulfilled. In the mid-1990s, urban woodfuel supplies were as freely available as ever in The Gambia and the natural woodlands were far from depleted.

<sup>77</sup> ORGATEC (1983). Underline in original.

In Mali, a study published in 1984<sup>78</sup> examined woodfuel supply and demand and reached similarly alarming conclusions. Table 5.1 gives details of Zone 5, which lies to the south of the country. It is the most densely populated region and includes the capital city, Bamako. The rainfall lies in the range 800-1400 mm/yr.

The breakdown between the different types of vegetation cover in the region is given in the table, together with estimates of the total annual wood increment for each type. It can be seen that the greater part of the overall total increment is in the open woodland/savanna and tree-formation categories. The study assumed that half the total wood production in the catchment area was accessible to woodfuel consumers.

Woodfuel consumption in Bamako was taken to be 1.7 kg per head per day, which for a population of 1.1 million gave a total annual consumption of 683,000 tonnes or 990,000 m<sup>3</sup>. Charcoal consumption accounted for only a small proportion of this figure but appeared to be growing rapidly. Rural consumption was estimated based on the available woodfuel survey data and gave a figure of 3.9 million m<sup>3</sup> roughly four times the urban consumption. A comparison between the total estimated consumption in the woodfuel catchment area and the accessible annual increment is given in Table 5.2 and shows consumption to be almost twice the accessible supply. The report judged the situation "critical".

**Table 5.1: Woodland production in the Bamako region of Mali (1980)**

<i>Type of wood resource</i>	<i>Area (sq km)</i>	<i>Annual production (thousand m<sup>3</sup>)</i>	<i>Standing stock (m<sup>3</sup>/ha) **</i>	<i>Standing stock (thousand m<sup>3</sup>)</i>
Open woodland/savanna	20,000	1,600	9	18,000
Tree formations	24,000	1,440	8	19,200
Shrub formations	11,000	165	1	1,100
Fallows	18,000	450	4	7,200
Farmland woods*	16,000	240	4	12,800
Plantations	20	35	50	100
Totals	89,020	3,935		58,400
Accessible		1,967		29,200

Source: Table 12 C Annexe III 1 m<sup>3</sup> is taken to weigh 700 kg

\*Boisés ruraux

\*\*The stock figures are taken from a contemporary Club du Sahel study of Mali<sup>79</sup> and quoted in the study. The total standing stock figures are calculated using the areas given in the table.

Three alternatives scenarios, entitled pessimistic, medium and optimistic, were then constructed in order to examine possible ways of dealing with the crisis. Three options were considered: the diffusion of improved stoves in the urban and rural areas; the promotion of butane as an alternative cooking fuel in the urban areas; and the restriction of the growth in charcoal consumption.

<sup>78</sup> TRANS ENERG (1984), (1985).

<sup>79</sup> Club du Sahel (1982) p37. The report quotes stock figures: 7.2 m<sup>3</sup>/ha in areas of 800-1,000 mm rainfall/yr; 8.7 m<sup>3</sup>/ha in areas of 1,000-1,200 mm rainfall/yr; and 10.5 m<sup>3</sup>/ha in areas above 1,200 mm rainfall/yr.

**Table 5.2: Comparison between production and consumption in Bamako region (1000 m<sup>3</sup>)**

Urban consumption	990
Rural consumption	3,913
Total consumption (A)	4,903
Total annual production	3,550
Accessible annual production (B)	1,953
B-A	-2,950
Situation	CRITICAL

Source: Table 3A Annexe III

Table 5.3 shows the results of the projections. In the pessimistic scenario, the diffusion of improved stoves results in a per head saving in woodfuel consumption of 5 percent by 1992; the use of butane substitutes for 16,000 tonnes of woodfuel; and the consumption of charcoal increases to 71,000 tonnes. In the optimistic scenario, the woodfuel saving from improved stoves is 32 percent per head; butane substitution is equivalent to 39,500 tonnes of woodfuel; and charcoal consumption is limited to 59,000 tonnes.

**Table 5.3: Three woodfuel consumption scenarios for Bamako region (1000 m<sup>3</sup>)**

Scenario	1982			1987			1992		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Pessimistic	990	3,912	4,903	1,318	3,920	5,238	1,618	4,163	5,781
Medium	990	3,912	4,903	1,235	3,806	5,041	1,490	3,616	4,961
Optimistic	990	3,912	4,903	1,133	3,501	4,634	1,118	2,986	4,104

Source: pp 253-255 Annexes III

Even the optimistic scenario shows a woodfuel consumption of 4.1 million m<sup>3</sup> in 1992, which is twice the estimated annual yield so that, based on the analysis, "mining" of the stock is inevitable. Simple calculation shows that by 1991, all the accessible stocks in the Bamako catchment area have disappeared and there is no accessible annual woodfuel yield. A further eight years mining of the inaccessible resources, sees these also completely depleted. Even the fairly heroic assumptions of the optimistic scenario do little more than delay the complete disappearance of the woodfuel stocks in Zone 5 of the country by a few years. Needless to say, nothing of the kind has happened.

The above two examples are typical of many that could have been chosen. They show clearly that the predictive power of the "energy-gap" analysis is extremely poor. Despite the fact that the apparently urgently required plantations have not been created and most of the other remedial programmes have fallen far short of their targets, the predicted catastrophes have not occurred. In most places, woodfuel supplies continue to be delivered more or less as before; prices do not seem to be escalating much faster than the general rate of inflation; the natural woodlands, although perhaps showing further signs of being battered by human interventions of various kinds, have not vanished from the landscape.

It is also worth noting that the policy prescriptions of these "energy-gap" based studies would not have solved the problems they identified. Even if the measures proposed under the optimistic scenario in Mali had been implemented, they would have made



little significant difference, merely delaying the predicted total depletion of woodfuel resources by just a few years. Nor has the analysis anything to offer on what comes next after the woodlands have been completely stripped away. The “energy gap” analysis, in short, does not provide a basis for rational policy-making in relation to woodfuel supply.

## 5.2 What exactly is wrong with the “energy gap” analysis?

Although many of the results it produces are clearly wrong, there is a seductive attraction about the “energy gap” analysis; otherwise, it would not have remained so popular for such a long time. It seems to provide a clear and logical method of analysing the complex and important issue of woodfuel supply. Why then is it so calamitously poor as an analytic method?

The basic reason is that there is a fundamental problem with the way stocks and yields are treated. The approach is also extremely sensitive to the assumptions built into it. An initial error magnifies itself with extraordinary rapidity when it is projected forward. Moreover, the “energy gap” analysis takes no account of the extremely important feedback mechanisms that operate in the real world. As one commentary in the late 1980s said:

*The crucial flaw in this apparently reasonable methodology is that it greatly exaggerates the need for planned interventions. It implies that all supply-demand adjustments must be implemented when in fact many of them will be made (and are already being made) “naturally” by ordinary people without any external assistance. This fault could be corrected by better information, thus putting gap theory on a respectable footing; but until this has been done, the method must be regarded as a dangerously misleading assessment and planning tool.<sup>80</sup>*

### 5.2.1 Commercial woodfuel harvesting

The basis of the “energy gap” analysis is the comparison between woodfuel consumption and the annual yield or increment in the growing stock. It is assumed that when consumption exceeds the annual yield, there is a decrease in the growing stock that in turn leads to a decrease in the annual yield.

In the case of commercial woodfuel harvesting, the major difficulty with this element of the analysis is that it bears little relationship to the way harvesting is carried out in practice. When commercial woodcutters or charcoal-makers start working in a woodland area, they take the mature stock; when this has been extracted they move to another area. In other words, irrespective of the magnitude of the annual increment, commercial woodfuel harvesting always depletes the stock. The amount of stock cut increases in line with consumption.

While stocks are being depleted in the areas where harvesting is occurring, the annual increment elsewhere may be adding to stocks; alternatively, because it is left unused, it may be rotting away in the natural processes of woodland growth and renewal. In other areas, because the woodland has reached a mature state, and is not being harvested, the net annual increment may be close to zero. Comparing the commercial woodfuel off-

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<sup>80</sup> Leach and Mearns (1988), p9.

take with the annual increment in an area therefore provides little useful information about what is actually happening.

Nor does the fact that stocks are being cut for woodfuel, in itself, mean anything significant. It does not automatically mean that the capacity of the cut over area to produce more trees has been destroyed. Removal of the mature stock from a woodland area, on the contrary, is, if anything, more likely to stimulate rather than destroy its productive capacity. When the area has regenerated, it can re-harvest. Commercial woodfuel cutting can thus be more accurately likened to long-rotation sustainable harvesting than “mining” of the woodfuel catchment area.

### 5.2.2 Rural woodfuel consumption

Two assumptions about rural consumption are usually made in “energy gap” analyses. One is that consumption continues to increase in line with rural population growth. The other is that rural woodfuel harvesters deplete stocks in the same way as commercial harvesters. Both are highly questionable.

Rural woodfuel consumption is not an immutable datum.<sup>81</sup> If nearby woodland resources become scarce, rural people are not compelled to continue inexorably into an ever-deepening woodfuel “gap” as they strip their woodlands of their last growing trees. Instead, consumption patterns vary with time and adjust to the availability of supplies. As a 1980s commentator remarked:

*This Malthusian woodfuel gap perhaps best represents the chasm in our thinking about the dynamics of woodfuel supply and demand, and about the way, rural people go about responding to woodfuel scarcities. The bias inherent in most analyses is that aid-financed project interventions are the solution. In many areas, however, rural, people are already responding to increased woodfuel demands in ways that are innovative and imaginative...<sup>82</sup>*

The pessimistic consumption scenario for the Bamako woodfuel catchment shown in Table 5.3, for example, attributes almost 80 percent of the 1982 total woodfuel consumption and, by implication, the same proportion of the “mining” of woodfuel resources to rural consumption. Even in the 1992 projection of the optimistic scenario, with its distinctly implausible dissemination of improved stoves in the rural areas, rural consumption still accounts for 73 percent of consumption and “mining” of the stock.

Taking into account the fact that most collection from the natural woodlands is by women and children, gathering mainly dead wood, it is reasonable to suggest as an alternative hypothesis, that the impact of rural harvesting upon stocks is so small that it can be ignored. If that is done, and the impact of rural consumption is discounted completely, the woodfuel “deficit” shown in Table 5.2 disappears completely and urban consumption is still below the accessible annual production even in the pessimistic scenario for 1992. Instead being on the verge of complete extinction, the bulk of the stock remains available for supplying the urban demand.

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<sup>81</sup> This is discussed further in Section 2.3.1.

<sup>82</sup> Dewees (1989)

### 5.2.3 *Urban woodfuel projections*

Reliable statistical data on all of the important parameters that determine urban woodfuel consumption are extremely scarce in most developing countries. Estimates of population and population growth rates, for example, are usually little more than educated guesses or extrapolations from past census data, itself often open to question.

Figures based upon surveys of typical households are likely to over-estimate consumption if they are grossed-up to cover the whole urban population. This is because the interviewees in such consumption surveys tend to be settled families with regular woodfuel consumption patterns. The poorer groups living in shanty accommodation are likely to be cooking less food and scavenging rubbish for burning rather than replicating the behaviour of the better off. The assumption that they consume the same amounts of woodfuel can greatly inflate total urban consumption figures.

Surveys of incoming woodfuel-carrying transport should, in principle, be able to corroborate the results of consumption surveys but are difficult and expensive to carry out properly. It is not unknown for the results of consumption and transport surveys to differ by a factor of two or more. In the case of the Mali study, the 1982 consumption figures were extrapolated from 1978 data in which a transport survey gave a total of 159,000 tonnes whereas the figure adopted for the analysis was based on a sample consumption survey from which the total was estimated to be 298,000 tonnes.

Assuming a credible figure can be obtained for the baseline level of woodfuel consumption, the next task is to arrive at a reasonable basis for projecting this into the future. The most common approach is assume that consumption per head or per family will remain constant and the total will grow in line with population growth projections. Both are highly unlikely.

Urban food consumption patterns change with time. Newly arriving families from the rural areas tend to bring their traditional cooking and eating habits with them. The routines of pounding millet and long hours of stirring traditional stews and porridges, however, gradually give way to habits more typical of towns especially for families in cramped accommodation or where women are able to find paid employment. Many workers take breakfast or lunch at small kiosks or restaurants rather than eating at home. The average woodfuel consumption per family tends to decrease.

The fact that both fuel and food have to be bought in the urban areas is a particularly important factor in bringing about changes in cooking habits. It especially applies to women entering the urban workforce. Complicated tradeoffs between the time spent cooking, expenditure on fuel and expenditure on food have to be made. Bread and pre-processed foods can offer savings in cooking and preparation time as well as reducing fuel consumption. Many families begin to avail of them, again reducing fuel consumption.

The rich and upper middle classes begin to shift away from woodfuel to the use of kerosene, LPG and electricity and this can sometimes extend down the income scale quite quickly. Ethiopia, for example, is one of the world's extremely poor countries yet there has been massive penetration of kerosene into the urban cooking fuel market. A

World Bank study<sup>83</sup> in 1994 noted that 91 percent of households had a kerosene stove compared with virtually none in 1980; in addition, 62 percent were found to own an electric *mtad* a flat electric plate used to cook the traditional *injera*, the round flat bread which is a staple of the Ethiopian diet.

The precise evolution of domestic fuel consumption in each urban area depends on its own special circumstances. The danger in projections of woodfuel consumption is that any starting errors in the baseline figures will be magnified as they are projected forward. If, in addition, no account is taken of the effects of changing fuel patterns as diets change and people become more urbanised, the errors will be compounded.

Again, this can be illustrated by the Mali example. By adopting the data from the transport survey and assuming a slight fall-off in the consumption per head, the 1992 figure for Bamako's consumption could be well below that shown in the optimistic scenario without any significant dissemination of improved stoves or promotion of substitute fuels.

Credible projections of urban woodfuel consumption require a substantial amount of work to establish a plausible starting point. They also require a reasonably in-depth sociological investigation of trends and the actual trade-offs that people make between time, overall household expenditure and use of woodfuel. In all the uncertainty, perhaps the greatest certainty is that woodfuel consumption growth rates will tend to decline with time and growth in the urban population.

#### 5.2.4 Woodfuel prices

Rising woodfuel prices are frequently quoted to support the results of "energy-gap" analyses, which reveal woodfuel is becoming scarce. For this to be believable woodfuel prices should be quoted in constant terms but this is rarely done. Moreover, it would need to be shown that any rise in prices was a genuine result of woodfuel scarcity rather than other factors, for example, an increase in the price of vehicle fuel pushing up transport costs or simple opportunism on the part of woodfuel dealers.

Leach and Mearns<sup>84</sup> quote from the 1987 *Tropical Forestry Action Plan*, which was supported by the World Bank, FAO, UNEP and the World Resources Institute. This states "*Shortages (and the distances over which fuelwood must be transported) have caused prices to rise so sharply in recent years that the wood used for cooking often costs more than the food cooked.*"<sup>85</sup> The authors then go on to show the flaws in this apparently authoritative pronouncement.

They found three main types of woodfuel price movement. In a number of major cities, including Abidjan, Ghana and Dakar, which are commonly seen to be suffering or heavily at risk of woodfuel shortages, prices showed a long-term fall. In other cities, including Casablanca, Khartoum and Yaoundé, prices had remained stable. In other cities, including Addis Ababa, Nairobi and Dar es Salaam there were rises, which seemed to be related to the rise in oil prices in the 1970s and 1980s, followed by falls.

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<sup>83</sup> World Bank (1995) p ix

<sup>84</sup> Leach and Mearns (1988)

<sup>85</sup> This, in itself, is a highly implausible assertion. It implies that people would do better to burn dried food than buy woodfuel.

Barnes<sup>86</sup> suggests a three-phase price model for developing country cities. The first phase is that of early urban growth when peri-urban woodfuel resources are abundant and prices remain low. The second phase is described as follows:

*...population growth causes deforestation and degradation of land around cities. Because consumer demand is above the rate at which trees regrow on common land, there is a mining of tree stocks and the price of woodfuels...flares up past the price of alternative fuels. The length of this period can depend on factors such as the rate of regional tree regrowth, the available stocks of trees and the population growth rate. At the end of this stage, there may a massive substitution of charcoal or kerosene for wood depending on their relative prices.*

In the final stage in this model, woodfuel prices rise above the price of conventional fuel alternatives; this is plausible because of the lower price of woodstoves in comparison with those for kerosene or LPG. This final price for woodfuels may be high enough to encourage farmers to plant trees for woodfuel

Contemporary data on woodfuel prices which would verify the truth, or otherwise, of this broadly credible model are difficult to find. Surveys carried out under the Household Energy Project in Niger, for example, found no strong trends between 1986 and 1994. In Burkina Faso, woodfuel prices doubled, in real terms during the 1970s, were stable up to 1985 after which they dropped slightly.<sup>87</sup>

The available information on woodfuel prices trends thus gives little support to the “energy gap” analysis findings of rapidly accelerating woodfuel scarcities. It would appear that woodfuel prices in most of the dry tropical woodland countries do not show any consistent upward trend and are still below that at which deliberate tree growing for woodfuel would be a financially attractive option.

### 5.3 An alternative view

The above analysis shows some the major weaknesses in the “energy gap” method of analysis. In addition to being unrealistic in its portrayal of how commercial woodfuel harvesting is actually carried out, its lack of feedback mechanisms ensures that any initial errors are greatly magnified in the result. It ignores the real flexibility and responsiveness of the woodfuel supply system.

The pessimistic scenario for Mali, shown in Table 5.3, can be used as an example of how some adjustment of the methodology and the assumptions fed into the analysis can produce a radically different output. This scenario shows a total rural and urban consumption in 1992 of 5.781 million m<sup>3</sup>, which is three times the accessible annual production (Table 5.1). In accordance with the “energy gap” model, this results in a stock “mining” rate of some 4 million m<sup>3</sup> with consumption continuing to rise, the lifetime of the woodlands in the catchment area is clearly going to be very brief and no effective policy response is available.

<sup>86</sup> Barnes (1992)

<sup>87</sup> World Bank (1991) *Burkina Faso: Urban household energy strategy*. ESMAP, World Bank, Washington, DC.

Consider instead the proposition that the rural population is not “mining” the stock. Instead, widely dispersed throughout the catchment, relying upon small dead wood from the bush, harvesting wood from fallow lands, trimming farm trees, using supplementary fuels their woodfuel consumption has no significant impact on stock levels. Even if this is not completely true, the supply problem, rather than being “critical” at the beginning of the analysis in 1982, is still well in hand in 1992.

Alternatively, consider the issue from the viewpoint of urban consumption. Assume it grows as in the pessimistic scenario but eventually levels off at say 2 million m<sup>3</sup>. The question is how this can be met.

The total stocks in the catchment area at the time of the study were about 58 million m<sup>3</sup> of which half were judged accessible. If the woodfuel harvesters rely solely on the accessible resources, it will take 15 years to harvest all the stocks in the catchment. In practice, over that period, some of the inaccessible resources will become economic to harvest and woodfuel dealers will travel further from the city to obtain their supplies. The process will be accelerated if woodfuel prices begin to increase because of scarcity. The depletion period will gradually extend to 20 years and then beyond it as these additional resources are harvested. This will provide a more than sufficient time for regeneration of the initially harvested stock, ensuring that the urban supply remains indefinitely sustainable.

Assuming, in addition, that the commercial woodfuel harvesters concentrate on the areas with the highest standing stocks in the catchment. From Table 5.1 it can be seen that these areas, with stocks of 8-9 m<sup>3</sup> per ha, cover 44,000 sq km. The total area that needs to be harvested to produce 2 million m<sup>3</sup> is therefore about 2,400 sq km giving a rotation period of just under 20 years. Moreover, the area harvested is just 2.6 percent of the catchment. The remaining 97 percent is available for rural consumers to meet their cooking fuel needs. Given the level of annual production in the total catchment, and the availability of complementary fuels of various types, this can clearly be done without any serious encroachment on the stocks available for commercial harvesting.

If woodfuel prices begin to rise, farmers may also decide to grow trees for woodfuel. Normally trees would be grown for more valuable products such as fruit or poles but woodfuel could be produced even from these by trimming and pollarding. There are no firm data on what might be the annual yield of trimmings from such a tree. One plausible suggestion is 20 kg per year;<sup>88</sup> a total of 15 trees would produce one m<sup>3</sup> per year.

Taking this as a starting figure, the remarkable potential of this kind of tree growing – at least in theory - can be illustrated by an extreme example. With an average density of 15 persons per sq km, the total population within a 200 km radius of Bamako is 1.9 million, 300,000 families confirmed. If each family planted five trees per year over a twenty-year period, the sustainable trimmings from these would be sufficient to supply 2 million m<sup>3</sup> to Bamako on a sustainable basis. No one is suggesting that this could, or should, happen, especially if supplies are freely available from the natural woodlands but the potential is clearly there and experience from Kenya, Pakistan and elsewhere shows that it can emerge when the price and other conditions are right.

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<sup>88</sup> Weber (1986)

Other possibilities could be explored. Tree stocks are almost certainly considerably higher than assumed in the study. The same is probably true of yields. The starting value for urban consumption could plausibly be half that taken; the rate of growth is likely to be less than assumed.

The exact figures in these calculations are, however, not important since they are not attempting to predict exactly what is going to happen in the Bamako woodfuel catchment. Their point is to show that the supply and demand system is far more flexible and adjustable than the “energy gap” analysis allows. Far from a runaway crisis, in which the countryside is being stripped of woodland resources, the evidence points to a dynamic and broadly sustainable equilibrium. As an analysis on these lines carried out in the mid-1980s, and so far borne out reasonably well by events, pointed out:

*...it is possible to interpret the available information in a radically different manner from that conventionally done. The evidence presented here suggests that there is neither an existing energy problem nor any serious prospect of one over the next couple of decades in the rural areas. The level of woodfuel resources available from the natural bush to supply Bamako also appears to be adequate to meet demands over the next twenty years and well beyond.<sup>89</sup>*

Removing the analysis from the “energy gap” framework, allowing for feedback effects, taking into account standing stock figures and the capacity of natural woodlands to recover after harvesting, and adopting more realistic estimates of woodfuel availability allows a startlingly different picture to emerge. The dynamic processes of woodfuel collection and consumption, urban population growth and changing fuel use, rural agriculture and fuel collection, natural woodland growth and regeneration all continue within a context in which adjustment and feedback mechanisms are constantly at work. Instead of runaway acceleration into insoluble problems, the typical picture is of a much more stable and sustainable system.

This explains why the predicted “woodfuel crisis” has failed to materialise. It also goes a considerable way to account for the failure of so many woodfuel projects over the past twenty-five years. Leaving out the social and technical problems that beset many of these projects, rural people are highly unlikely to undertake arduous or urgent action to avert woodfuel supply problems, which they do not themselves perceive. If a woodfuel crisis is not likely to occur, there is little incentive to take troublesome measures to deal with it.

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<sup>89</sup> Foley (1987)





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## Natural Woodland Management Experience

By the early 1980s, it was evident that plantation forestry, on which so much hope had been placed, provided no solution to what was still seen as the rapidly approaching woodfuel “crisis.” The more perceptive policy-makers were already beginning to look at the possibility of managing the natural woodlands for woodfuel.

This chapter focuses on two innovative natural woodland projects, both in Niger. The Guesselbodi project was the first to concede a major role in large-scale natural woodland management to local communities. Overlapping with this was the World Bank’s Niger Household Energy Project, which provided new insights and took a number of important further steps in handing management responsibility to local communities. One of its major innovations was to assist rural communities to establish rural woodfuel markets from which they could benefit directly.

Both projects contributed to a revision of many commonly held views and progressively clarified thinking about the issues involved in dry tropical woodland management. The present challenge is to take that thinking forward.

### 6.1 Reassessing the potential of the natural woodlands

The efforts put into large-scale plantation forestry and the promotion of farm and community woodlots in the late 1970s and early 1980s were driven by the belief that the productivity of the natural woodlands was so low that they could not meet projected woodfuel demands. As experience showed the survival and growth rates of fast-growing exotic species to be disappointing, forest research turned back towards a re-evaluation of the potential of the natural woodlands. The Sahelian drought of 1983-84, with its particularly damaging effects on exotic species, emphasised the need for new approaches.

It also began to be more widely recognised that the natural woodlands provide village communities with much more than fuelwood. They are the source of the poles and timber required for building, fencing, tool and furniture making and many other uses. Trees provide the browse without which livestock cannot survive the dry season. Woodlands produce fibres, food, medicines and other locally valued products. They act as habitats for wildlife which can be hunted for food or for sale. Most of these benefits are lost if the woodlands are given over to plantations.

Taking these, previously neglected, benefits into account, the case for maintaining and managing the natural woodlands, instead of trying to replace them with plantations, began to appear more attractive. If improved woodland management techniques could be developed and applied on a sufficiently large scale, woodfuel supplies could be increased to meet the coming energy shortages. At the same time, local people would benefit from the

preservation of the capacity of the woodlands to provide the products on which they depended.

A national forestry conference held at Maradi in Niger in 1984 received wide publicity and was an important turning point for forest services and donor agencies across the Sahel. It produced a series of declarations and political undertakings among which major emphasis was placed on the need to bring the country's natural woodlands under management in order to reduce the degradation taking place and counter the threat of desertification. It was accepted that this could only take place with the active collaboration of local people and, after the Maradi conference, the use of a local cooperative became a mandatory element in all natural woodland management projects in Niger.

## **6.2 The Guesselbodi Project experience**

The Guesselbodi Project, which was carried out with funding from USAID, was the first major natural woodland management project in the Sahel based on large-scale community involvement. The project was planned with great care and became well known nationally and internationally. It played a major role in raising awareness of the potential benefits offered by natural woodland management and was quickly followed by similar cooperative projects in Niger and elsewhere.

The Guesselbodi National Forest is located some 25 km south east of Niamey, the capital of Niger. It is an area of natural woodland covering about 5000 ha and was in a severely degraded state at the beginning of the project. The aim was to bring it under management in order to restore its productive potential and thereafter use it as a sustainable source of commercial fuelwood for Niamey.

In 1984, when the project was being planned, there was a vigorous debate, which took place among foresters about the future of the Sahelian natural woodlands. It was by no means universally agreed at the time that natural woodland management was even technically feasible. Some foresters believed that many woodland areas were completely dead, or beyond the possibility of regeneration, because of drought and over-use. Others were of the view that with restorative measures and protection against grazing, much of the natural woodland cover could be restored. The Guesselbodi project set out to establish how, at a technical and social level, natural woodland management could be carried out, how much it would cost, and what yields of firewood and other forest products could be obtained.

The Niger forest service was the national implementing agency for the project and retained its statutory control over the woodland area. Initial planning and preparatory work began in 1984. The first step was to prepare a map of the whole area showing its soils, vegetation, landforms and areas especially susceptible to erosion. Surveys were also carried out in the surrounding villages to identify how these made use of the woodland area. A cooperative incorporating the nine villages surrounding the area was set up in 1986.

A management plan for the whole woodland area was developed and discussed with the villagers. Under this plan, the woodland area was divided into ten parcels of 500 ha each. Work programmes were developed for each parcel according to its soil and ecological characteristics. The intention was that each parcel would in turn be subjected to a range of rehabilitation measures. The treatment in each parcel would be carried out over a year, after which the next parcel would be treated, giving a ten-year period to cover the whole area.

The rehabilitation measures included blocking gullies with stone check-dams and the creation of small berms to trap rainwater run-off and increase infiltration. The purpose was

to encourage the regeneration of the naturally occurring grasses, bushes and trees. Special half-moon shaped micro-catchments were also created in which individual trees were planted. These measures were far beyond the physical capacity of the forest service and the arrangement was that they would be implemented by the local population in return for payments in cash or food - a relatively conventional arrangement in development projects at the time. The innovative feature of Guesselbodi was that the local population would subsequently participate in the management and controlled exploitation of the area, under the direction of the forest service, in return for which they would be allowed to harvest and sell firewood and animal fodder.

In the event, the rehabilitation work was carried out by around 100 paid labourers from the villages in the cooperative under the supervision of forest service foremen.<sup>90</sup> Around 100,000 seedlings, mainly local species, were planted each year with a particular emphasis on legumes and trees most valued by the villagers. There was also extensive seeding with *Andropogon gayanus*, a perennial grass that is highly regarded in the area as animal fodder. It is reported that the rehabilitation measures cost up to \$670 per ha.<sup>91</sup>

Protection of tree and grass seedlings in newly planted areas was provided for a minimum of three years by guards paid for by the project. Owners of animals caught in these areas were fined in accordance with the number and type of animals trespassing. Light branches cut from trees during harvesting were spread over barren areas to provide a protective cover, allowing regeneration of grasses and the growth of tree seedlings.

The management plan envisaged the ten parcels being harvested for fuelwood in turn, giving a ten-year rotation for each. The cooperative members would carry out the harvesting, with the forest service designating the parcel in which it would take place each year. The forest service would also arrange the purchase of fuelwood from local people and its onward sale to commercial dealers. The price paid to the woodcutters, and that at which fuelwood would be sold, would be set by the forest service, with the difference used to cover the running costs of the project.

The early results were extremely encouraging. After the harvesting of firewood in the first parcels, there was a rapid regeneration of shoots from the cut trees and a copious growth of grass. This was a major breakthrough. It resolved the forestry arguments and showed that natural woodland management could be made to work at a technical level even in badly degraded areas.

Nevertheless, a variety of social and managerial problems gradually began to emerge. There was, for example, considerable resistance to the project by pastoralists. They deeply resented being excluded from grazing areas to which they felt they had traditional rights of access and on which they depended for dry season fodder. They also feared that any extension of the scheme would mean they were banned from an ever-increasing proportion of their traditional grazing areas.

The size of the project caused considerable access problems for the participating villages. Some found themselves up to 20 km from the areas they were entitled to harvest for firewood and fodder. This was much too far for people without access to vehicular transport and they lost interest in taking part in the project.

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<sup>90</sup> This description of the project is drawn mainly from Heermans (1986) unless otherwise noted

<sup>91</sup> Kerkhof (1990)

There were tensions and misunderstandings between the village cooperative members and the forest service. Guards, for example, interpreted their instructions to mean the entire woodland area was closed to everyone except those authorised to collect firewood and grass. The collection of other products, on which local people, especially women, had traditionally depended, was excluded.

Funding for the project ended in 1990. A review carried out in 1993 rather depressingly observed:

*"At Guesselbodi, USAID support has ended, and the activities carried out with project support are now largely discontinued - the systems and institutions created are not functioning as intended. There is poor management of funds, little accountability, and perhaps most importantly, grazing is not effectively controlled following the initial cut. The cooperative no longer has the means to pay guards, nor to pay for soil and water conservation activities, largely because disciplined management of funds was not applied and (as the team was told on several occasions) the cooperative members did not have sufficient managerial or technical skills. (This was indeed a surprising observation in view of the reputation of the excellent training given at Guesselbodi during project implementation)."*<sup>92</sup>

The early successes at Guesselbodi inspired a number of other similar projects in Niger. These all broadly followed the same model of establishing a cooperative of the villages surrounding the managed area, paying for woodland rehabilitation work, and the use of paid guards to protect the managed areas. The experience has generally been similar to that at Guesselbodi. After an initial period of enthusiasm and activity, woodfuel production and cash turnover have tended to fall off.

Management performance in the cooperatives has tended to be poor, with considerable amounts of fraud and financial indiscipline. A review in 1991 found that the cooperatives had a poor understanding of their precise role in relation to the various other organisations involved in the setting up and overall management of the schemes. Inter-village disagreements have also been a factor. As in Guesselbodi, the sheer size of the forest areas brought under management has created major problems. Moreover, management plans, which in practice tend to be developed more or less in isolation by forest technicians, can be difficult for local people to understand or accept.

### 6.2.1 Lessons from the project

The Guesselbodi project deserves its pioneering reputation. It showed that, at a technical level, natural woodland management for a sustained firewood yield is possible. It also highlighted, for a wide international audience, the fact that the natural woodlands are far more than a source of woodfuel. They act as a multi-faceted resource for the rural communities, which live in and near them. Equally importantly, it made clear that these communities needed to be involved on a voluntary and continued basis, rather than as paid labourers, if a sustainable method of natural forest management were to be developed.

The Guesselbodi project, while it opened the way for local community involvement in natural woodland management, also showed the limitations of the approach it adopted.

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<sup>92</sup> Christopherson et al (1993).

Although the costs were a small fraction of those involved in plantation forestry, or even conventional forest management, the approach was not sustainable.

Expensive woodland rehabilitation measures, such as micro-catchments and water-retaining berms, will not be carried out or maintained by local communities when project funding ends; the same applies to the payment of forest guards. The limited administrative capacities of local communities also mean that complex woodland management and revenue-sharing arrangements are unlikely to survive.

### **6.3 The Niger Household Energy Project: research findings**

The Niger Household Energy Project was conceived in the mid-1980s. The initial analysis, typically for its time, revealed a runaway woodfuel crisis and the project was designed to respond to it. A demand-component was designed to promote the dissemination of improved woodstoves and to encourage a shift from woodfuel to kerosene. The innovative supply-component was designed to build upon the Guesselbodi experience and has greatly advanced the discussion on natural woodland management.

The project was officially launched in 1989. Once it was under way, woodland management trials and monitoring exercises, designed to establish the most effective method of natural woodland management were undertaken. They took place near Tientiergou to the south of Niamey in an area of some 30,000 ha of natural woodland within which are found about 20 smaller villages or hamlets. Woodfuel resources are substantial and although exploitation is still relatively limited, it is an important reserve of fuelwood for Niamey. There was considerable interest among villages in developing the fuelwood trade and four villages agreed to participate in the trials, which covered a total area of about 5,000 ha.

#### *6.3.1 Harvesting the woodlands*

The Tientiergou study encouraged the local woodcutters to harvest the woodlands in their own traditional manner. It was reasoned that if this could be adapted or modified to conform to the requirements of sustainability, there was a much greater chance of it being locally acceptable than any attempt to introduce completely new techniques. The results were highly encouraging.

The study found that, because of the various forest laws prohibiting tree cutting, local woodcutters usually operated furtively, cutting only a small number of trees in any particular area to avoid detection by forest officers; they were, in effect, harvesting the woodland in a highly selective way. This minimises the impact of the harvesting, leaving the basic woodland structure completely intact and appeared ideal for sustainable management. Work was therefore carried out on ways of developing and testing a few simple and locally acceptable rules based on the “furtive” or selective cutting approach.

The researchers found that restricting cutting to a minimum diameter of 6 cm seemed to provide an optimum balance. It means that many healthily growing stems of reasonable size are left behind after harvesting and the woodland regenerates in a balanced manner. The fact that a substantial proportion of the shoots left behind are reasonably mature also means that the time to the next harvest of the area can be substantially reduced.

Rather than the ten, twelve or even twenty-five year rotations commonly recommended for natural woodland management, the study found after a period of about six years re-

harvesting would be worthwhile. This greatly simplifies the management technique. Dividing an area into six parcels, each with a rotation period of six years, rather than twelve parcels each with a rotation of twelve years, makes for a much more easily visualised and remembered management system at the local level.<sup>93</sup>

An additional benefit of this approach is that the value of the forest in terms of nuts, herbs, fruits, honey, medicinal materials and other products, mainly collected by women, remains intact. It also remains as a reserve for the small wildlife, which forms an important part of the local diet. Increased numbers of guinea fowl and francolins (partridges) both of which can be readily sold have already been observed in the managed woodland areas in Tientiergou. This has generated considerable local enthusiasm especially among women.

The study also found that local woodcutters had themselves decided, without any prompting from the project, to protect rings of trees around lowland areas where temporary or permanent accumulations of water occurred. The reason given by the woodcutters was that they wished to protect the water sources from sand invasion. In the case of external woodcutters from the city, similar considerations would not apply. The incident clearly reveals that given control over their own wood resources, local people are quite capable of exercising restraint in their cutting, provided they see good reason for doing so.

The study also produced important information about tree cutting and revealed that there are serious conflicts between what is easiest for woodcutters and what is best for regeneration. When the maximum degree of regeneration is the objective, the optimum time for cutting is just before the beginning of the rainy season. If this is done, there will be sufficient water available for the nourishment of the new shoots when they appear. Moreover, their rapid growth during the rainy season will mean that they have begun to lignify and become sufficiently large to be less attractive to grazing animals searching for browse in the following dry season. The height at which the tree is cut is also important; to encourage regeneration it should be as close to the ground as possible.

For the woodcutter, this type of harvesting is far from ideal. The traditional axe is of poor quality and is difficult to use if the cut is too low or too high for a comfortable swing. The ideal cutting height from the woodcutter's point of view is around 50 cm above the ground. The time of cutting also affects the ease of working; woodcutters prefer to work on trees when they are full of sap, which makes them easier to cut.

The fact that the easiest method of harvesting is far from the optimum for regeneration is unimportant to paid woodcutters from outside the area, for whom, ease and speed of cutting are the primary considerations. For local woodcutters, aiming to harvest the woodland sustainably, however, it is a matter of more concern. Work was therefore carried out to find a compromise method of cutting, which would favour regeneration while not unduly burdening the woodcutters.

### 6.3.2 *Findings on protection against grazing after harvesting*

The need to provide complete protection against grazing animals for at least three years after an area has been harvested for woodfuel is almost an axiom of natural woodland

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<sup>93</sup> The data supporting these conclusions still, however, need to be confirmed by long-term follow-up and further studies. These will also provide information on longer term survival rates, the actual quantities of harvestable wood obtained at the end of the six-year rotation period, and the sensitivity of the regeneration and yield to rainfall fluctuations and the intensity of grazing.

management. The reason why is easy to understand. The soft shoots which spring from newly cut stumps or freshly germinating seeds are quickly eaten whenever livestock gain access to them. If woodland regeneration were to occur in an area, it would appear essential to protect it completely until these shoots have established themselves.

However, enforcing such grazing bans is prohibitively expensive if paid guards are used. It is also full of practical difficulties. There is, for example, the problem of ensuring that pastoralists are properly informed about the exact areas where grazing is not allowed. Even if they are informed, some pastoralists may choose not to respect the ban. Pinning responsibility for trespass on particular pastoralists is especially difficult. Unless their animals are actually found on the land, any damage found is always by animals from elsewhere.

Keeping their animals out of specific areas is also difficult for herders, even if they are willing to do so. Herds are normally allowed to wander freely through the natural woodlands during the dry season, since herders know that the animals will return each evening to the well, which provides their water. Where there are no other water sources, there is no problem in keeping track of the livestock and management of even large flocks is a practical possibility. It is much more difficult to control the detailed movements of the flock to keep the animals out of particular areas which they find attractive. Mounting full time guard to prevent the flock obtaining fodder from sources to which pastoralists feel they have traditional rights of access is not an attractive or readily acceptable option.

Grazing bans can also introduce a significant degree of social discord between herders and woodcutters. The Tientiergou experience was that woodcutters, because of the support provided by the project, were attempting to ban pastoralists from using their traditional grazing areas. This was doubly unacceptable to the pastoralists who felt entitled to the grazing due to their traditional rights and deeply resented any attempted interference with these by woodcutters, a traditionally subservient group. Under such conditions, grazing bans may turn out to be impractical at a local level without the permanent presence of project personnel.

The Tientiergou trials therefore investigated whether grazing bans were necessary. A total of 35 plots, each with an area of 0.1 ha, were chosen for monitoring after fuelwood harvesting in 1990. Some were fully protected against grazing while others were left open.

The results of these trials overturned the conventional wisdom on the need for elaborate and prolonged grazing protection after fuelwood harvesting. The most surprising finding was that there was virtually no difference between the protected and unprotected plots, which had been harvested in the traditional "furtive" manner. In the plots subject to grazing, only 2% of the new shoots were eaten. Protection against grazing would therefore not appear to be necessary. Indeed, as the studies on the dynamics of the tiger bush<sup>94</sup> showed, the likelihood is that grazing bans, so notoriously difficult to enforce and the cause of so many project problems can, in fact, be quite counterproductive.

These results have been confirmed by follow-up on 25 other plots in Tientiergou and another location where woodcutters using the same "furtive" or selective woodcutting approach had exploited the woodland. The key factor appears to be the selective harvesting. The scattered felling of trees avoids the creation of concentrated areas of newly regenerating

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<sup>94</sup> See Section 3.4

vegetation attractive to livestock. The animals therefore browse more randomly through the woodland permitting it to regenerate normally.

### 6.3.3 Guidelines for natural woodland management and grazing protection

The guidelines drawn up by the Household Energy Project for the management of the natural woodlands drew upon these findings. Some are quite contrary to the widely accepted orthodoxy.

The project recommended that woodfuel harvesting should follow the local traditional practice of selective cutting. This can be formalised into a number of simple rules, which are easily understood and acceptable to local people. Thus, for example, the pioneer tree species *Guiera senegalensis* and *Combretum micranthum* should not be cut until they reach a base diameter of 6 cm - the thickness of a wrist. The later species *Combretum nigricans* and *Combretum glutinosum* should not be cut until they reach a base diameter of 8 cm - the thickness of an ankle. Potential timber species, such as *Pterocarpus lucens*, should be left until they reach a base diameter of 35 cm, subject to local agreement.

Rules can also be agreed with the local community about not cutting species, which produce fruit such as *Tamarindus indica*, until they have died naturally. Similarly, species, which provide browsing, particularly vital to livestock survival in times of drought, should generally not be cut. Such formal rules may, indeed be superfluous since villagers will tend to do this in any case if they have control over their areas of natural woodland and are entitled to exclude external woodcutters from them.

The compromise recommended by the project on cutting trees is that the cut should be 20-40 cm above ground and that the felling should be between April and June. The trees should then be left to dry where they are cut, supported on mulch formed from their own small branches, until the following year. During this time, the bark is eaten by termites thus returning the greater part of the nutrients to the soil. When it comes to market, the dry bark-free wood is in optimum condition for sale and highly attractive to buyers.

The project also recommends that areas where fuelwood harvesting has been carried out should be given some protection during the rainy season immediately following the cutting. Using branches from the felled trees to protect cut stumps and spreading the more sensitive fringe areas with branches can do this. Ideally, this protection should be supplemented by some additional seeding of the fringe areas of vegetation patches with desirable tree species - some of which may previously have grown in the area but have been eliminated by drought or over-cutting.

Fostering regeneration in this way is an achievable objective. By the time the new shoots have appeared, many of the livestock herds are already on their way to their northern grazing areas and those that remain have to be controlled, in any case, to prevent them destroying crops. Avoiding the areas, spread with branches is an additional, but potentially acceptable, limitation if the herders have been consulted and feel they will subsequently benefit though increased availability of fodder and browse. Even if there is some accidental livestock access to these areas, the protection provided by the branches will prevent the complete destruction of the newly emerging shoots. In subsequent years, the need for protection is greatly reduced and livestock can be allowed access.



## 6.4 The Niger Household Energy Project: implementation

The project started with the view that natural woodland management could make economic, environmental and social sense if it could be carried out cheaply and effectively. An earlier study carried out by one of the project designers stated that "*...a rational management of the natural woodland formations in the area around Niamey would permit a major portion of its fuelwood needs to be met for a considerable period of time into the future.*"<sup>95</sup> The aim of the project was to put in place a practical strategy for achieving this.

Niamey, the capital, was the principal concern. Its estimated annual fuelwood consumption was 130,000 tonnes. The aim of the demand component of the project was to prevent this rising significantly by encouraging the dissemination of improved stoves and promoting the use of kerosene as a cooking fuel.

### 6.4.1 The rural fuelwood market concept

Guesselbodi provided a model, of sorts, for a fuelwood supply system based on natural woodland management. However, the results then becoming available indicated that the approach adopted, radical though it had been, had not gone far enough. The costs were far too high and the fuelwood produced could not compete on the market without a substantial subsidy. It was also clear that the management system was turning out to be beyond the capacity of the villages involved.

More importantly, it was becoming obvious that the local communities, though they were willing to carry out the forest rehabilitation and protection tasks set for them by the forest service on a paid basis, would not be prepared continue them voluntarily once the project ended. The Guesselbodi approach was thus not sustainable without continued substantial support from outside donors.

If a self-sustaining natural woodland management system were to be devised, it would have to be much cheaper and simple enough for rural people to manage on their own. It would also have to offer such self-evident benefits to local communities that they would be prepared to implement it voluntarily and without external subsidies. The project therefore proposed the establishment of rural fuelwood markets run by a "local entity" such as a village, cooperative of villages, or canton. Once the project was under way, it became evident that the most logical choice was a single village. In Niger, as in most of the Sahel, the village is the primary social and land-management unit.

Each market would draw its fuelwood from an area of natural woodland formally delimited and agreed between the village and the local government authorities. In contrast with the Guesselbodi arrangements, these markets were intended to be commercially independent and self-sustaining. The village would set the selling price for the fuelwood and there would be no price subsidy available from project funds.

The woodland area would be managed in accordance with a simple plan agreed between the project and the village. This would also include an annual fuelwood quota designed to restrict market sales to the amount, which could be sustainably produced from the managed area of woodland. Village members would carry out the harvesting and the woodfuel

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<sup>95</sup> Madon (1986)

merchants would purchase the fuelwood from the village market and transport it to the urban areas.

#### *6.4.2 New fuelwood legislation and changes to taxation system*

The proposals were radical and involved substantial legislative changes to enable the new fuelwood markets to be established. It was also evident that successful implementation of the rural market system on the lines envisaged required comprehensive changes in the fuelwood taxation and control system covering the whole fuelwood catchment zone of each major urban area. Fuelwood dealers, for example, would need to be provided with financial incentives to use the markets rather than the open woodlands; and there would need to be controls and penalties to ensure the new system was not misused.

Draft legislative proposals were published at the end of 1989 and were discussed for two years in a series of seminars and meetings involving representatives of all parties. The final proposals were presented to the government in 1992 and the legislation setting up the markets and changing the woodfuel taxation system came into effect in 1993.

Under the new provisions, the existing widely-abused arrangement of annual cutting permits and extremely low taxes on the quantities of wood transported was scrapped. In its place, there was a completely new fuelwood taxation system operating on the basis of differentially priced permits, or coupons, specifying the quantity of wood which could be carried on each individual journey and its origin.

Dealers obtaining fuelwood from a rural market would pay for the coupon at the time of purchase. Those obtaining their load from an uncontrolled area of natural woodland would have to obtain their coupon, at a considerably higher price, in advance. The coupons, which would have their own distinctive colours, would be checked at transport control posts set up on the main entry routes to the urban areas. Rural markets levied a tax on all sales.

As a further refinement, it was decided that the system could be used to discourage dealers from obtaining their supplies from the more heavily degraded woodlands close to the urban areas in favour of the more remote and better-endowed areas. This would be done by applying a differential tax on fuelwood, depending on how far it was harvested from the urban area. The difference in tax would compensate for the extra transport costs incurred in obtaining supplies from the more remote areas.

Arrangements were agreed with the government under which tax revenues were shared between the markets and the various authorities involved in the scheme. One of the important provisions was that proportion of the taxes levied by the markets would be paid into village funds for expenditure on communal purposes decided on by the village leaders. In all, it was calculated that the extra taxation revenues would be more than sufficient to cover the costs of implementing and running the system.

The weaknesses in the existing woodfuel control system were fully recognised and the decision was made to upgrade it completely. The intention was that control posts would be set up on all the main vehicular routes into the urban areas and would be manned 24 hours per day. Staff would be properly trained. Supervision would be improved and there would be a clamp down on fraud and evasion.

### 6.4.3 The woodfuel resource base

A major study of woodfuel availability around four of the major towns in Niger had been carried in 1981 under an earlier project.<sup>96</sup> This used aerial photographs supplemented by ground truthing at about 170 sites. The Household Energy Project updated this using 1988 Landsat data and ground truthing for a catchment area of 150 km radius around each of the main towns in the country. The exploitable woodfuel was defined as the species currently used for woodfuel above a diameter of 4 cms. Only clearly defined areas of natural woodland were taken into account since it was not practical to assess wood resources on fallow lands, farmland and other non-woodland areas.

The study showed that the conditions of the woodlands varied greatly. In some areas, they were so heavily degraded that little, if any, commercial fuelwood supply could be obtained sustainably from them. Elsewhere, resources were more abundant and capable of providing substantial quantities of fuelwood on a sustainable basis provided they were properly managed.

The woodland areas in the catchment were divided into three categories depending on their stocking density based on field inventories of sample areas. Details are shown in Table 6.1.

**Table 6.1: Standing stocks and estimated annual yields around Niamey**

<i>Woodland Category</i>	<i>Vegetation cover (%)</i>	<i>Area ha</i>	<i>Standing stock t/ha</i>	<i>Annual yield t/ha</i>	<i>Total stock tonnes</i>
1	over 60	251,100	3.3	0.3	828,630
2	20-60	849,487	2.1	0.18	1,783,922
3	below 20	1,337,513	0.9	0.06	1,203,761

Source: Schema Directeur p. 220.

### 6.4.4 Fuelwood Supply Master Plans

Woodfuel supply master plans for Niamey and the other major towns were drawn up. The aim was to ensure that areas where woodland resources were sufficient to provide a sustainable supply would be given priority in the establishment of the rural markets. Fuelwood harvesting would gradually be restricted and eventually prohibited in areas where the natural woodlands were incapable of supporting it sustainably.

### 6.4.5 The overall Supply Component strategy

The implementation of the project was thus a complex process.<sup>97</sup> It envisaged an interlocking series of actions involving the following steps:

modify existing law to create a new set of rights for villages enabling them to exercise control over the natural woodlands in their area;

bring the exploitation of the whole of the natural woodland areas used for fuelwood supplies to the main urban areas gradually under control;

<sup>96</sup> The USAID-funded Forestry Land Use and Planning Project (FLUP).

<sup>97</sup> Montagne et al (1994)

reorganize the whole of the national fuelwood trade by means of new control systems and regulations;<sup>98</sup>

use the taxation system to favour fuelwood production from managed areas and those with the highest resources rather than those where resources were heavily depleted.

provide material incentives for villages to enter into forest management contracts with the relevant local government authorities;

put in place an effective system of control of the entry of fuelwood into the urban areas;

provide the government with sufficient revenues from fuelwood taxation to cover the costs of implementing the project.

#### 6.4.6 *Establishing a market*

The area of land "belonging" to a village is normally a product of historical population movements, inter-ethnic conflicts, colonial interventions and a variety of other factors. As a result, some villages, often the longest established or those of traditionally dominant ethnic groups may control large areas of natural woodland while other villages in the same area may have few effective rights over the woodlands around them.

The project accepted that it was not practicable to use the introduction of rural markets as an occasion for attempting to impose a more equitable distribution of land rights between villages. Such a task was far beyond its abilities and resources. Neither could the project take upon itself the task of defining the "ownership" of the different areas of land over which various customary rights were claimed and exercised. It therefore decided to restrict the establishment of rural markets to villages, which could show they had undisputed fuelwood-harvesting rights to the woodlands around them or were able to secure agreements on such rights with neighbouring villages without any pressure or intervention by the project or the government.

In cases where local customary systems for the allocation and sharing of land and natural resources already existed, the project attempted to involve these in the process of delimiting the area of natural woodland over which a village could claim control. By invoking the help of these existing social control systems, the intention was to provide additional support and legitimacy to the newly established rural markets. The project also decided that it would be best to try to establish markets in groups of four or five adjoining villages at the same time. As well as providing some economies of scale in publicity and training, this also assists in the territorial delimitation exercise.

Even with these conditions, however, agreeing the areas of control of the first villages selected for the establishment of rural markets proved to be a long and complex process. It involved the use of aerial photographs, numerous trips to landmarks, and long discussions with village chiefs. The process was so drawn out and complicated it was clear it could not practicably be repeated on a national or regional scale.

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<sup>98</sup> It was initially envisaged that all transport by camels and donkeys would be forbidden. The owners of these animals were instead to be encouraged to offer their services to rural markets, transporting fuelwood from the place of cutting to the point of sale. This would also help fuelwood dealers by eliminating the need for off-road journeys with the risks and damage they entail for vehicles. The practical difficulties in implementing this were, however, too great.

Instead, it was decided that these discussions should be undertaken by representatives of the various villages themselves in conjunction with the local canton chief. The villagers would then produce an agreement in which the area was defined by local landmarks such as roads, riverbeds and other prominent features. An official from the Department of the Environment would then be invited to visit the defined area with the village representatives concerned and record it officially.

Under this procedure, key landmarks defining the agreed boundaries are marked on a map with their local names and identification. In addition, their precise coordinates are established using the Global Positioning Satellite system and recorded on the map. The labour involved in making this formal record is still substantial; delimiting a 1000 ha woodland can involve 20 km on foot in the bush. However, it can be accomplished in a day. The cartographic details are then sent to Niamey where they are recorded in the computerised information system set up by the project. The final map is then printed out and confirmed or amended by a final trip around the perimeter.

Two types of market are covered by the project. In the case of the “controlled” market, a management plan, specifying the division of the woodland area into parcels, the order of their harvesting, and the management measures to be applied, is agreed with the village. In the “directed” market, the area of the natural woodland is delimited but no formal management plan is established. Both types of market are subject to an annual woodfuel-harvesting quota laid down by the forest service, based on the yield estimates for the area in the fuelwood supply master plan.

#### *6.4.7 Achievements and problems*

At the beginning of the project, when the initial promotion of the rural markets was getting under way, there was a high degree of distrust on the part of villagers. Many were unable to believe that a real transfer of control over their woodlands was being offered to them or that they would truly be given discretion over the spending of funds. The project succeeded in overcoming much of this distrust and rural communities became increasingly enthusiastic. In some areas, without any intervention by the project, villages began to apply spontaneously to have a market.

It was also found that a number of villages adjacent to functioning markets, again without any intervention by the project, had begun to refuse access to fuelwood dealers while they are waiting for the establishment of their own market. In one area, a number of markets have banded together to harmonise their prices and prevent themselves being played off, one against another, by fuelwood dealers.

At the end of 1995, a total of 85 rural markets were in operation most serving Niamey. The total amount of fuelwood sold to Niamey was about 75,000 stères, about 16 percent of its total requirement. The total revenue to the markets, less-taxes, was just over 100 million FCFA (about US\$170,0000).

About 80 percent of the total revenues went directly to village woodcutters; about 12 percent went to village funds; and the remainder went to the market managements. Total taxes were 22 million FCFA of which half went to the national treasury with the remainder being allocated between the local forest service and the village community for investment in woodland management and general social welfare initiatives. The amounts involved at an individual village level are small but overall there is a significant transfer of resources from the urban to the rural areas.

Other aspects of the programme were, however, less satisfactory. The taxation system was not functioning properly despite considerable efforts and investment on the part of the project and the overall collection rate was about 30 percent. Bookkeeping in many of the rural markets was poor, with many records being incomplete, confused or inaccurate. Some of these shortfalls are clearly a result of lack of the necessary bookkeeping skills but there was also evidence of fraud, with some market managers being prepared to arrange with transporters to avoid paying tax.

The fuelwood quota system was also looking questionable. Unless the quotas can be accurately monitored and checked for their relevance, they have no impact on woodfuel harvesting practices and simply reduce the credibility of the project. Nor is it likely, given the weaknesses already emerging in the tax collection and record-keeping areas, that a credible system for setting and monitoring quotas for the projected total of over 400 rural markets can be established or sustained.

The project, in other words, was showing signs of being too complex for the available skills and supervisory structures. In the absence of a continued and substantial input of external donor funds, its survival in its planned form is unlikely. This is being borne out by events since the end of World Bank funding in 1997.

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## Developing an Intervention Strategy

The conventional view of woodfuel harvesting is that it is a major threat to the dry tropical woodlands. The consequences of this bias towards crisis in policy making in the woodfuel sector are almost entirely negative.

If woodfuel harvesting is a threat, measures must be put in place to restrict it. Taxes must be imposed reduce consumption. Alternative fuels must be promoted, sometimes at very large expense in donor and government funds, to reduce woodfuel consumption. Quotas must be set for harvesting. People must be encouraged and subsidised to plant trees for woodfuel. At the same time, it has to be recognised that few of these measures actually work as intended.

The main thesis of this review is that it is legitimate to take a different approach. The old methods of estimation and calculation greatly exaggerated the dangers posed by woodfuel harvesting. They undervalued the contribution the dry tropical woodlands can make to sustainable energy supplies to the urban areas. They imposed elaborate and unsustainable administrative and supervisory superstructures on essentially simple projects. They blocked access to more flexible and innovative approaches.

Instead of engaging in a largely futile, and often counterproductive, campaign to restrict and control woodfuel harvesting, it needs to be seen positively. The reality is that cities and rural areas do not run out of cooking fuel. If food is available, people find a way of cooking it.

The challenge is to ensure that the potential of the natural woodlands to meet these cooking fuels needs is recognised and the opportunity presented by woodfuel harvesting as used as creatively and productively as possible. It potentially provides a means of improving one of the largest economic sectors in some of the world's poorest countries as well as a rare chance to make a useful contribution to the quality of life in the rural areas.

### 7.1 Assessing the woodfuel supply-demand balance

The woodfuel supply assessments of the past produced a far too pessimistic picture of the potential for sustainable supplies from the catchment areas around the major urban areas. It is now becoming clear that a different and more realistic approach can be taken.

#### 7.1.1 *Identifying the resource base*

The resource base in the woodfuel catchment area consists of all the wood, which can be used as fuel. For urban use, this can be taken as all the wood of a commercially attractive size, say above 4 cm in diameter. The figure for the available domestic cooking fuel in

the rural areas is much larger since it includes not just smaller wood sizes but, in principle, the whole burnable biomass.

When looking at the available woodfuel stocks in a catchment area, existing woodland inventories may be able to provide the stock figure for the potential urban supply. They need to be checked to ensure that the minimum size included is appropriate. It is also important that the stocks available from crowns, branches and under storey are included. Where these are not included, a simple percentage addition to the existing inventory may be sufficient; in others, surveys that are more detailed may be required to obtain the necessary figures.

The growing stock of trees on fallow lands is available for woodfuel but is likely to be lower than that from woodland not converted to farming. An increase in the rural population, bringing an extension of the farmed area, may therefore bring a reduction in the woodfuel stocks available in the future. Some rural areas are relatively ripe for population expansion. Others, because of the poor agricultural returns and difficult living conditions, are already suffering from labour shortages and declining agricultural production. Local social and geographical studies may be required to provide a basis for making a judgement on what is most likely to happen.

The spread of cash-crop farming and other land uses that involve total and permanent clearing of the natural woodlands must be considered. If it is significant, it needs to be factored into projections of potential supply. The possibility that the expansion of small-holder farming will lead to an increase in tree growing if wood from the natural woodlands begins to become scarce or woodfuel prices rise to a sufficiently attractive level also needs to be considered.

The annual yield concept is still relevant in this analysis but it is an abstraction, which must be used extremely carefully in relation to woodfuel harvesting if it is not to produce highly misleading results. Rather than a measure of the amount of wood, which can safely be extracted, it gives an indication of the rate of regeneration likely to occur in areas where the mature woodfuel stock has been harvested. It provides a measure of the rotation period, the length of time, which must elapse before an area that has been cut for woodfuel can be re-harvested. It is important that, rather than relying on possibly unreliable conventional figures, a realistic value is taken.

It is important to take into account the fact that woodfuel catchment areas are always shifting and extending around the cities they are supplying. Urban woodfuel dealers naturally use the most accessible resources first; as these are depleted, they travel further out along the main transport routes for their supplies. This increases dealers' costs but not necessarily by any great amount. Woodfuel supply routes of three or four hundred km are common in the dry tropical woodland areas and have not priced woodfuel off the market. In some cases, the additional costs are offset by the fact that the woodfuel is a return load, carried by vehicles, which have been delivering commercial goods to provincial towns.

Woodfuel supply areas also tend to extend laterally from the main roads. Large woodfuel trucks usually cannot penetrate far from the roads into the rural areas but local people acting on their own behalf or as agents of woodfuel merchants are able to cut and carry woodfuel to vehicle pick-up points. Depending on the distance, loads can be carried by people, animals or carts. Sample surveys will provide information on what is happening.



The conventional woodfuel analysis portrays the woodfuel catchment area as a static entity essentially defined by a single parameter, the sustainable yield. In fact, it is in a continuing state of change. Woodfuel stocks are being depleted; but they are also being renewed. Land is being taken from woodland production in the peri-urban areas, but the collection areas are extending outwards from the city. Trees can, and will be grown if the price and other conditions are right. The woodfuel supply system is more likely to be in a state of dynamic equilibrium than accelerating collapse.

### *7.1.2 Assessing woodfuel demand*

The woodfuel demand in the catchment area should be seen as a highly variable element in the overall woodfuel system rather than the fixed datum used in conventional woodfuel analyses. This variability can be seen both cross-sectionally between socio-economic groups and longitudinally with time.

Socio-economic studies of typical household consumption, differentiating between income groups, need to be carried out as part of any woodfuel demand assessment. Applying average consumption figures obtained from household surveys across the whole urban population, as is sometimes done, can conceal important variations. It can easily exaggerate total consumption figures, for example, if poor and rich families are assumed to be purchasing the same quantities of woodfuel as those with middle-incomes.

There are major variations in urban cooking fuel patterns with time. The growth of small restaurants and street kiosks; the level of availability of partly or fully processed foods; and the sale of kerosene, LPG and electric cooking appliances are all indicators of change in cooking fuel use. Socio-economic surveys can provide information on what is happening at any given point and make some assessment of trends. This can provide a basis for a more realistic extrapolation of woodfuel consumption trends than simple linking with population growth predictions.

Woodfuel price data, corrected for inflation, also need to be assembled. Even if prices show a rising trend, the possible reasons behind this need to be examined; the assumption that price increases inevitably signal increasing scarcity of resources is not necessarily correct. The possibility of opportunistic price rises, imposed as a result of increases in the price of kerosene or other fuels, bad weather making transport difficult, or other factors need to be given due weight. Any data that can be collected on price elasticity will be particularly valuable. If real price trends and elasticity can be identified, they can help in making consumption projections more realistic.

Rural woodfuel consumption is even more variable than in the urban areas. Consumers have a wide variety of alternatives and supplementary fuels available for use at different times in the year or on a permanent basis. The assumption that rural people have an immutable pattern of woodfuel consumption that is responsible for large-scale depletion of the dry tropical woodlands is clearly wrong. Time, distance and other constraints ensure that obtaining their cooking fuel supplies is a flexible and responsive process with a generally low impact on the environment.

Sociological studies, rather than consumption surveys are needed to elucidate exactly what is happening in rural woodfuel collection and use. These surveys can provide data on how people react to pressure on their time during, for example, peak periods in agricultural activities and how they deal with scarcities of woodfuel, which may arise for other

reasons. The safest assumption may be to ignore rural woodfuel consumption completely when assessing the total demand in the catchment.

### 7.1.3 *The supply demand balance*

Given the problems and limitations that normally apply to household energy data in the developing world, assessing the supply-demand balance involves dealing with a high degree of uncertainty. It could also be expressed, more positively, by saying that it involves recognising flexibility. An FAO publication of the early 1980s remarked:

*Woodfuel supply and usage are usually embedded in a complex system within which most of the factors that affect the ability to intervene with forestry solutions are of a non-forestry nature. They are primarily human factors, connected with the ways in which people organise their lives and use their land and other resources...Simply measuring wood fuel use and the tree resource, while a necessary part of the whole, will by itself give very little indication of what can and should be done.*<sup>99</sup>

The initial need is for a simple broad-brush approach, which will provide an overall picture of the existing state of the supply-demand system. If this indicates a broad dynamic equilibrium, it needs to be verified by a more detailed check on potentially critical parameters. The system can then be examined more closely to see if there are opportunities for fruitful intervention in order to improve the way it is working. It may be, for example, possible to make it economically more efficient by removing bottlenecks or increasing competition. Redistribution of some of the rewards away from urban dealers towards the rural areas, by establishing rural woodfuel markets, may be possible.

If the initial supply-demand comparison, or the more detailed analysis, reveals that the system is not in balance, and woodfuel resources are being depleted significantly faster than they are being renewed, certain obvious feedback mechanisms will come into play. Prices will rise, encouraging consumers to use their woodfuel more efficiently and shift to alternative fuels. The rate of increase in consumption will fall; consumption itself may even begin to fall. As woodfuel becomes scarcer, it will increasingly acquire a cash value in the rural areas. Rural people will have an increased incentive to switch to low value local fuels and sell the woodfuel. Some will begin to cultivate or plant trees.

The task will be to identify exactly what mechanisms are at work in balancing supply and demand. It then becomes possible to look for feasible and useful interventions, which will improve the welfare of the various people involved in the system, perhaps ameliorating the impacts of the changes on the most vulnerable. It may be possible to remove bottlenecks from the market ensuring greater competition and cheaper fuels. Reform of forestry legislation may be required to encourage, even permit, rural people to grow and sell trees for woodfuel. The forest service may be able to help farmers wishing to grow trees with seedlings or provide advice on setting up rural nurseries. Investments may be required to expand the alternative fuels supply network.

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<sup>99</sup> Arnold (1983)

## 7.2 Rural woodfuel markets: a devolution of responsibilities

At present, the rural woodfuel market system pioneered in Niger is the leading model for major woodfuel interventions in the dry tropical woodland areas. It is essentially a means of devolving responsibility for woodland management to local communities and can provide a variety of significant benefits.

There is, nevertheless, a considerable amount of hesitation about the extent to which responsibility for the management of the natural woodlands can safely be entrusted to local communities. It is commonly feared that unless woodfuel harvesting is tightly restricted, rural communities will rapidly deplete their woodlands and accelerate the slide into a major woodfuel supply crisis.

The attempt to retain control over woodfuel harvesting can result in unwieldy, expensive and, ultimately, unsustainable administrative and taxation systems. Where woodfuel shortages are not in prospect, these control systems can obviously be greatly simplified. Given the difficulties in making them work properly, and their potentially counterproductive effects, it is arguable that, even if woodfuel supplies are becoming scarce, these complex systems serve little useful purpose.

### 7.2.1 Rural market benefits

The rural market system can provide a number of significant benefits, as exemplified in the case of Niger. Where it is not in place, the possession of a cutting permit, in practice, gives a woodfuel merchant complete authority to cut as much woodfuel as he wishes in an area without any regard to local interests, or payment for the wood abstracted.

Although this type of harvesting does not destroy the woodland, it is clearly short of the optimum from the point of view of regeneration and the general functioning of the woodland as a local resource. It also discourages any local efforts to manage or preserve the woodland since the main beneficiaries will be the external woodcutters. The market system changes this.

The woodland can be managed in the way local people wish; sensitive areas can be protected and particular trees preserved. Local management also brings cash reward, which represents a transfer of resources from the urban to the rural areas. The fuelwood growing in the village woodland acquires a value it did not have before and there is an incentive to ensure that regeneration is facilitated. The cash-yield of the woodland will be taken into account when alternative land uses, such as agriculture, or the annual burning are considered by the village community. The rural market system, in other words, introduces the essential pre-conditions for rational land-use management and opens new opportunities for the people living in the areas where they are established. A commentator on the Sahel noted the following:

*Forests can serve as a motor for development if local populations can retain surpluses that are normally captured by merchants and other state actors higher in the market. The idea is that forest management should provide more than subsistence labor opportunities. It should profit the*

*community. If it can generate revenues above the costs of maintenance, then it can be a tool for development and change.*<sup>100</sup>

It is, nevertheless, important to keep this in proportion. The rewards from woodfuel harvesting are low. In the Niger project, for example, the maximum harvesting quota was one stère per ha. If this were observed, the average cash yield, based up the actual selling price of the woodfuel in the markets, would be under \$2.50 per ha per year. Even with markets in place, the low financial yields of woodfuel harvesting are therefore unlikely to deter local people from converting their woodland areas to agriculture or other more rewarding uses if the opportunity should arise.

### 7.2.2 Management plans

Management plans are assumed an essential element in any devolution of control over natural woodland resources to local communities. This often begs the question of what should be the precise management objectives.

It is generally taken for granted that the purpose of natural woodland management is to maximise the sustainable yield of wood; it is implicitly assumed that if this aim is pursued, then the woodland will continue to provide its traditional benefits in the form of grazing, fodder, herbs, medicines, wildlife and other products. Discussion with the various groups at a local level may well reveal that this is not necessarily the case and management objectives need to be discussed and agreed at a local level if they are to stand a change of long-term acceptability.

In entering these discussions, it is important that the whole local way of living and decision-making, in which woodfuel harvesting may be only a minor element, is taken into account. Management needs to be seen as a broad concept, the purpose of which is not to impose an oppressive or bureaucratically heavy system of control and regulation but rather to facilitate the creation of value for the local population. FAO has stated:

*Management must not be seen as something imposed from the outside by governments or forest services. Large areas of forest are under the management of the people living in and around them. Many such traditional management systems have worked well for long periods, and where this is, the case the optimum approach may well be to avoid any external interference. When the traditional system appears to be breaking down or is subjected to new demands it cannot meet, it does not necessarily mean that the system has failed completely and should be abandoned. The most effective approach will often be to reinforce the existing system or to help it to adapt to new circumstances.*<sup>101</sup>

Granted that a management objective has been defined, the exact means of realising it may not be immediately evident. One result of the uneasy and confrontational relationship between forest services and local communities in many countries is that little is known about the management of natural woodlands because it has rarely been seriously attempted on a large scale. Foresters, convinced that local people are bent on destroying the woodlands, have imposed a variety of restrictions; local people, for their part, have

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<sup>100</sup> Ribot (1995) p8

<sup>101</sup> FAO (1993) p 62

attempted to subvert these to the greatest extent possible. There is still much to learn about woodland management if a spirit of collaboration can be introduced.

The few available management data are generally from trials carried out under forest service supervision on relatively small plots. The applicability of such the results to a wide variety of local conditions and diverse management objectives is likely to be questionable in many cases. If local people are to be brought into willing collaboration, the management plans they are expected to follow must be flexible enough to allow them to react to changing local circumstances as they themselves judge best

It is also important that woodfuel markets are established wherever woodfuel is being harvested. Refusal to set up a market in an area because the woodfuel resources are already being over-exploited is likely to achieve the worst of all worlds. Woodfuel harvesting will almost certainly continue but in a completely uncontrolled way. These over-exploited areas are precisely where markets are most needed since local control is more likely to lead to rational management.

A final possibility, and quite contrary possibility, which needs to be given serious consideration, is that of disappointed expectations. Where woodfuel is plentiful, and competition between markets is consequently tight, sales may be lower than people expect. The problem facing markets in many areas may well be that of excessive supplies rather than exhaustion of resources. This is not as fanciful as it might appear. In the natural forest management project in Burkina Faso, some community wood cutting gangs found that merchants refused to buy the wood they had collected and prepared for sale. Rather than being sold, the wood had to be abandoned.<sup>102</sup>

### 7.2.3 *Harvesting quotas*

Harvesting quotas are a major feature of the Niger Household Energy Project. They are intended to restrict woodfuel consumption to levels compatible with the estimated sustainable annual yield from the area being harvested. Their use is, however, questionable on a variety of grounds.

Forest service staff; believe strongly in the need for harvesting quotas as a means of preventing irresponsible over-exploitation of the natural woodlands. They are logical products of analyses, which predict a "woodfuel crisis" and a need to restrict its consumption. However, even granted their necessity, they are virtually impossible to enforce. The level of woodland surveillance and record keeping required to monitor compliance with the quotas is beyond the capacity of most forest services. It is also easy to falsify the quantities of wood being transported as is commonly done in Burkina Faso.<sup>103</sup>

Arriving at a suitable quota is also methodologically difficult, given the lack of data on annual yields and regeneration times. It is also highly questionable whether the annual yield should be the basis of the quota. Restricting harvesting to the annual yield in a well-stocked area of woodland may mean that valuable stock is never harvested and simply rots away; in an area, which has been recently harvested, the same quota may well be

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<sup>102</sup> Kini (1994)

<sup>103</sup> Kini (1994)

excessive. The alternative, of trying to calculate a harvesting quota for every parcel in every market area, and keep it up to date, is impractical.

A fixed quota system, moreover, does not reflect the overall dis-equilibrium conditions found in the dry tropical woodland areas. Local people, if they are to survive, must respond and adapt as these major changes in their environment as they take place. Woodfuel harvesting is just one element in the rural pattern of existence:

*Income from woodland exploitation is a function of crop production and other economic opportunities and thus fluctuates considerably. Woodland management should respond to such opportunism. The imposition of<sup>104</sup> an annual yield or quota... is not useful since it does not respond to fluctuating needs.*

There is, thus, little overall justification for retaining the quota concept and this is particularly so if there is no overall "woodfuel crisis" in the area. The quota system, moreover, runs contrary to the overall concept of devolution of control to local communities. The following comments, made over a decade ago, eloquently summarise the issues and retain their relevance in this context:

*"It seems prudent, as a general policy, to transfer authority permanently and then let local people experience the consequences of their own management decisions. Such transfers should be preceded by careful discussion with local people on the terms and conditions of the transfer. If they maintain or develop the NF (natural forest), they will derive the benefits; if they reduce or destroy it, they will support the costs. Clearly, some communities will eliminate their NF capital for short-term gain, or because they cannot organize themselves to regulate its use. This is a serious risk, but one which must be taken if the policy is to succeed eventually. and it is certainly no more risky for NF maintenance than continuation of the official control measures which are presently inadequate in most areas."<sup>105</sup>*

Giving village communities genuinely full control means they are in a position to optimise their use of the woodlands in accordance with their own criteria. It allows them to make meaningful decisions on whether areas of natural woodland are best used for fuelwood or for the production of crops for subsistence or sale. Such decisions lie at the heart of the rural development process and impinge directly on people's livelihoods. It is surely best that they are made by the people who are most closely concerned with them and who will carry the costs of getting them wrong.

At the same time, there is a need for some caution. Handing control of local woodland resources carries risks but they are not necessarily the one about which the greatest concern is often expressed:

*Providing this right ...to commercialize should carry responsibilities and limits. It should be subject to limited technical constraints and to practices that conserve a sufficient forested area to continue to supply these*

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<sup>104</sup> Kerkhof (1998a)

<sup>105</sup> Floor and Gorse (1986).

*populations with the use values – food, fodder, fuel, fiber, medicines and dies – they have enjoyed in the past. These obligations are not just for protecting the forests, but also for protecting rural populations. However, this protection is not from themselves, as in the protection of forests from the “anarchic” “irrational” and “abusive” cutting by “hungry” “ignorant” peasants – terms that continuously arise to describe rural populations and to justify Forest Service control of the resource. Rather, this protection is from powerful individuals and groups within a highly unequal rural society, it is from powerful urban interests and it is from the Forest Service itself, which in all these countries has a history of allocating forest resources to powerful urban interests and individuals.*<sup>106</sup>

Achieving such a protection system is a major challenge to project design. It requires that certain safeguards be built into the system by which management authority is devolved to the local community. The most fruitful approach may be to ensure there is an adequate appeal or dispute-resolution system to which local people can have recourse with the details tailored to the specific needs and structures of authority in each case.

#### 7.2.4 Need for simplicity

Buying woodfuel from a rural market represents a loss of revenue to a woodfuel merchant. The surplus formerly gained from employing a gang of woodfuel cutters now goes to the market. The loss is unlikely to be great, given the wage rates of woodcutters and the margins in the woodfuel trade, but it is nevertheless an incentive to the merchant not to use the market. As long as merchants have free access to adequate supplies of woodfuel from the natural woodlands, the market system will struggle to survive.

Interim measures to encourage, or compel, merchants to obtain their supplies from markets may be put in place, but they will always be vulnerable to inefficiency or corruption. The imperative is to establish a critical mass of markets as quickly as possible. This will restrict the choice of harvesting location for woodfuel merchants and they will begin to use the markets because they are more convenient. The early markets will also act as a demonstration to other villages, encouraging them to apply for their own market.

Establishing a large number of markets quickly means the process must be as simple as possible. The minimum requirement is a legal and regulatory framework for the market system, defining the rights and duties of the market relative to the woodfuel trader; a system of registering the area of woodland falling within the authority of each rural market; a supervisory and dispute-resolution system; and a formal announcement that the market has been established. Anything beyond this should be viewed with caution and only attempted if it appears necessary and sustainable.

Demarcation of the village woodlands, for example, was rightly seen as a minefield by the Niger project and the main responsibility was passed to villages themselves. This is certainly correct. As much flexibility as possible should be introduced into the process and, to the maximum extent possible, villages should be allowed to work out their own agreements with neighbours. Some may wish for a rigid demarcation of their own area of woodland; others may wish for a looser arrangement in which access is shared with others.

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<sup>106</sup> Ribot (1995b)

The final agreement should also include any local arrangements made with pastoralists using the woodlands.

Management systems should be as loose as possible; quotas should only be imposed in highly exceptional cases, for well-defined reasons and when they can be effectively enforced and reviewed. Changes to the woodfuel taxation system should be kept to the minimum and should aim only at revenue-raising; because of the difficulties of putting them in place and ensuring they are collected, taxes intended to control or regulate the woodfuel trade are unlikely to be effective. A small levy on sales, used to cover the costs of market establishment and supervision, is far more likely to be effective and sustainable.

Adopting this minimalist approach will not reduce the efficacy of the rural market approach. On the contrary, by facilitating the rapid establishment of markets, it will enable it to be maximised. Because the continuing expenses and supervisory and administrative overheads are kept to a minimum, it will also greatly increase the chances of the rural market system being sustainable once the support provided by the initial external funding, if this is used, comes to an end.

### **7.3 Institutional constraints**

The central element in the rural market system is the transfer of control over local woodland resources from forest service or other government authorities to local communities. The exact form of the market, or indeed whether it is actually constituted as a physical entity at a precise place, are of far less importance than the devolution of control which takes place. The future may well see a variety of institutional arrangements and local structures emerging as alternative approaches to local management are explored.

In setting up rural markets and developing new approaches, one of the crucial lessons of experience to date is the need for realistic expectations. Radical transformations of institutions and legal systems are rarely delivered, though they may be promised. The most successful interventions are likely to take place within existing institutional frameworks. These will also have a reasonable prospect of becoming self-sustaining within the external funding period.

#### *7.3.1 Constraints on governments*

Over the dry tropical woodland areas, the majority of governments operate under extremely tight fiscal constraints; indeed some governments are barely functional. Essential services, mainly in the urban areas, must receive priority. A woodfuel supply system, which is reliably delivering supplies to urban consumers, is rarely going to be a major concern or a priority for action.

One of the legacies of the colonial era in most countries is a highly complex land tenure system in which customary rights and the modern legal code are interlinked or operate in parallel in a highly complex and even, at times, contradictory fashion. While land reforms, clarifying ownership, resolving disputes, securing private rights and other reforms or amendments may well be desirable; there is little realistic chance they will be implemented in the framework of a woodfuel programme. The issues are simply too complex and the vested interests too great for any major changes in land tenure systems to be readily accepted or quickly implemented.



If changes in tree ownership or rights over woodlands are sought, they must be within the boundaries of the practically possible. This was fully recognised, for example, in the Niger project where the legal changes required establishing the rural woodfuel markets were acceptable to the government. The project, moreover, stayed clear of any attempts to resolve territorial disputes between local communities. The role of the project officials was simply to assist in the demarcation and recording of agreed boundaries.

Taxation is another potentially contentious issue. Major increases in taxation on such a basic necessity as woodfuel are most unlikely to be acceptable to governments. Donor pressure will often obtain a variety of undertakings but implementing highly unpopular measures tends to be a different matter. Any tax increases that are proposed must be genuinely acceptable; this, in practice, means they must be small.

Nor can projects afford to be over-optimistic about the recycling of any woodfuel taxes into woodland projects. Tax revenues normally go the national treasury, which, in the majority of the dry tropical woodland countries, tends to be extremely hard pressed. Arrears of civil service salaries of many months are common and there are few funds available for even the most urgent current commitments let alone investments in woodfuel systems. The chances that any woodfuel taxes, which reach these treasuries, will be recycled in a timely way into forest service equipment or woodland rehabilitation measures are usually slight.

It is therefore essential to be realistic about what governments are prepared and able to do in the framework of a woodfuel programme. Promises may be extracted but the crucial question is whether they are likely to be fulfilled. The long term credibility and sustainability of woodfuel programmes will be fatally undermined if they are based on unrealistic assumptions about government actions or interventions.

### *7.3.2 Reform of forest services*

The forest services in the dry tropical woodland countries are usually long established and many have been in existence since colonial times. They are often the beneficiaries of legal systems which give them rights not just over officially gazetted forest lands but over natural woodland areas and even individual trees on farm and community lands.

Despite their draconian nature, however, forest regulations have rarely worked well in the woodfuel sector. In Ethiopia, for example, under the previous government, which had little compunction about the way it enforced its measures, woodfuel was supposed to be under the state-controlled Construction and Fuelwood Production, Processing and Marketing Enterprise. Despite this, the private sector continued to supply more than 80 percent of woodfuel to the main cities almost entirely from illegal operations.<sup>107</sup>

Most forest services are seriously under-resourced. They lack vehicles, equipment, trained support staff, and, in many cases, even basic office necessities. Salaries tend to be extremely low and are often far in arrears. Many forest service officers survive by having another job and working part-time on their nominal forestry duties, which cannot, in any case, be fulfilled because of the lack of resources. Nevertheless, the mutually-accepted pretence between donor agencies and governments that forest services with a few hundred staff, most without transport, are capable of controlling vast areas of gazetted forests and

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<sup>107</sup> Getta (1994) p19

public woodlands has led to the launching of a variety of highly complex and over-ambitious projects and their inevitable subsequent is failure.

Collection of woodfuel taxes is often the responsibility of forest services. The level of taxation is normally so low that it has no practical effect on the behaviour of woodfuel traders or consumers. In addition, only a small fraction of even these taxes reaches the government because either woodfuel dealers evade the system by paying bribes or the takings are shared out within the collection system. The real importance of many of the existing woodfuel taxation systems is that they provide a degree of self-financing bureaucratic employment. This is why they are so difficult to reform and why it is usually futile to try. In most cases, they do little harm and can be left in place but they do not provide a secure foundation for ambitious new woodfuel control systems.

It is far more important to tackle the basic problems of bullying and intimidation of rural populations by forest service officials. This can be done; experience in Mali, for example, is showing that the arbitrary powers of forest agents can, in practice, be curtailed. Reform of this kind will, of course, be resisted by forest services; but it will be welcomed by far larger numbers of rural dwellers. Nor is there any significant expense in implementing or monitoring such changes. Rural people and local village authorities are generally capable of refusing to pay fines and resisting arbitrary actions if they know there is no legal basis for them.

On the other side, it is also important to recognise that the forest service, in most of the dry tropical woodland countries, represents a significant source of trained personnel, which the country can ill-afford to waste. Rather than the intimidatory and counter-productive role which many forest service personnel now find themselves playing, they can be creatively deployed in environmental analysis, forestry research and monitoring, biodiversity and wild-life programmes as well as conventional duties within the gazetted forest areas. Many of these activities could, and should, be funded internationally as part of the ever-growing concerns about the global environment. There is an urgent need for a clear-sighted review and re-definition of the role of forest services and the role they should be expected to play in the dry tropical woodland countries in the future.

Weaning forest services from long habits of intimidation and corruption may be difficult task but it needs to be tackled; pretending the problem does not exist guarantees it will remain. Reform is not a process of dismantling existing well-functioning structures. It is far more a case of devising something, which works and will continue to do so. At the absolute minimum, woodfuel projects should not introduce measures, which reinforce the worst aspects of the existing system.

#### **7.4 Complementary initiatives in the woodfuel sector**

Initiatives such as the dissemination of improved stoves, the promotion of alternatives to woodfuels, and encouraging tree growing have almost all been justified on the basis of their contribution to "saving forests" and averting an "energy crisis." If there is no serious woodfuel problem in prospect, it becomes necessary to look again at initiatives of this type. Many can be justified on their own intrinsic merits that allow such programmes to be better focused and more effective.

Improved stoves, for example, are highly relevant if they are promoted with the direct intention of raising the standards of living of individual families. They are fully justified when they enable families to reduce their cooking fuel bills, are safer or more convenient

to use, and are priced at a competitive level. If they are designed to fit within the traditional stove-manufacturing system, they help create employment in the artisan and small enterprise sector where incomes are generally low and social needs are great. They provide people with a cushion against rising woodfuel prices and help prolong the production of wood from the rural areas if scarcities begin to develop.

The use of subsidies to encourage people to shift from woodfuel to kerosene or LPG, in contrast, is much more questionable. It is a process which takes place of its own accord as cities grow, and cooking and fuel-use patterns change. If there is no danger of woodfuels becoming scarce and expensive, subsidising alternative fuels, which benefits primarily the rich, should not be a priority. The shift to alternative fuels can simply be left to the normal working of economic forces and the evolution of urban fuel use patterns.

Promoting tree growing for woodfuel is highly questionable in a context where woodfuel supplies from natural woodlands are abundant. It should also be remembered that burning is the last-resort and generally least profitable use for wood. Growing trees for fruit, poles, construction wood or any other purpose is likely to be more attractive than creating a woodlot.

Forest services, and agricultural departments, have traditionally provided farmers with tree seedlings and advice on their cultivation. This role will continue to be valid but concentrating efforts on growing trees for fuel is likely to remain questionable. It is may be better to wait for it to happen, seeing it as indicator of market conditions rather than a programme objective

## **7.5 Looking to the future**

The flexible and dynamic nature of the woodfuel supply systems of the developing world is one of the main characteristics to strike the external observer. They deliver huge quantities of woodfuel reliably and cheaply to million of consumers. Despite the many predictions of catastrophe in the late 1970s and early 1980s, they look set to continue doing so well into the new millennium.

Any interventions must take this flexibility and dynamism into account. Both fuel consumption patterns and supply sources are in a continuing state of flux throughout the developing world. Whatever system is put in place must be capable of adjustment to changing circumstances.

The difficult conditions, the natural state of ecological and climatic dis-equilibrium prevailing in the dry tropical woodland areas mean people's way of life must be adaptable and opportunistic. If woodfuel harvesting is to be an attractive and stable proposition for local people, it must offer advantages over all the other possible uses of the same land. Attempts to restrict people's use of the natural woodlands around them are unlikely to succeed in the long term. Nevertheless, they are likely to be more adept at managing the natural resources of the dry tropical woodland areas than external experts or government officials who have no experience of actual living conditions in these areas. Rural people deserve the opportunity to apply their hard-earned experience in the way that they themselves choose.



## References

- Achard, F. (1997) *Pastoralisme Et Ecosystèmes Forestiers Contractés Du Sud Du Niger: Ressources Forragères Et Impact Du Pâturage Sur La Forêt*. Chapter in 'Fonctionnement Et Gestion Des Ecosystèmes Forestiers Contractés Sahéliens. Éditions John Libbey Eurotext, Montrouge, France.
- Anderson, D. and Fishwick, R. (1937) *Fuelwood Consumption and Deforestation in African Countries*. Staff Working Paper No 704, World Bank, Washington, DC.
- Arnold, J.E.M. (1983) Quoted from Introduction to FAO (1983).
- Barnes, D. F. (1992) *Understanding Fuelwood Prices in Developing Nations*. Energy Paper No 56, Industry and Energy Department, World Bank, Washington, D.C.
- Bonkougou, E. and Catinot, R.(1986) *Wood, Land and People. Woodfuel Dossier, Acp-Eec Courier, Jan-Feb 1986, Eec, Brussels*.
- Bradley, P. N. (1991) *Woodfuel, Women and Woodlots*. Macmillan, London.
- Cap, A. M., Germann, D., and Madon, G. (1980) *Les Cuisinières Ban Ak Suuf*. Centre D'études Et De La Recherches Sur Les Energies Renouvelables, Dakar, Senegal.
- Chidumayo, E. N. (1993) *Zambian Charcoal Production; Miombo Woodland Recovery*. Energy Policy, Vol 21 No 5.
- Chidumayo, E. N. (1997) *Miombo Ecology and Management*. IT Publications, London, and Stockholm Environment Institute, Stockholm.
- Christiaens, M. (1982) *Report on the Final Discussions about Dissemination of Woodstoves*. Woodstove Seminar, Katholieke Univesiteit, Leuven, Belgium.
- Christopherson, K. A. (1993) *Natural Forest Management in Niger: Economic, Ecological and Institutional Perspectives*. Subvention Au Développement Du Secteur Agricole, Phase II.
- Cills/Club Du Sahel (1978) *Energy in the Development Strategy of the Sahel: Situation, Perspectives, Recommendations*.
- Club Du Sahel (1982) *Analyse Du Secteur Forestier Et Propositions: Le Mali. Rapport*.
- Deweese, P. A. (1989) *The Woodfuel Crisis Reconsidered: Observations on the Dynamics of Abundance and Scarcity*. World Development, Vol 17, No 8, Pp 1159-1172.
- Earl, D. (1973) *Charcoal and Forest Management*. Commonwealth Forestry Institute, Oxford.
- Eckholm, E. (1975) *The Other Energy Crisis: Firewood*. Worldwatch Institute, Washington, D.C.
- Eckholm, E. (1976) *Losing Ground; Environmental Stress and World Food Prospects*. W.W. Norton, New York.
- Eckholm, E., Foley, G., Barnard, G. and Timberlake, L. (1984) *Fuelwood; The Energy Crisis that Won't go Away*. Earthscan, London.
- Fairhead, J. and Leach, M. (1996) *Misreading the African Landscape*. Cambridge University Press, Cambridge.

- FAO (1981) *Tropical Forest Resources Assessment Project (In the Framework of Gems): Forest Resources in Tropical Africa. Part II: Country Briefs*. FAO, Rome.
- FAO (1983) *Simple Technologies for Charcoal Making*. Forestry Paper No 41, FAO, Rome.
- FAO (1993) *The Challenge of Sustainable Forest Management: What Future for the World's Forests?* FAO, Rome.
- Foley, G. (1976) *The Energy Question*. (First Edition) Penguin Books, London.
- Foley, G. Et Al (1997) *The Niger Household Energy Project*. Technical Paper No 362, World Bank, Washington, D.C.
- Galle, S., Seghieri, H. Mounkaila, H. (1997) *Fonctionnement Hydrologique Et Biologique A L'échelle Locale: Cas D'une Brousse Tigrée Au Niger*. Chapter In 'Fonctionnement Et Gestion Des Ecosystèmes Forestiers Contractés Sahéliens. Éditions John Libbey Eurotext, Montrouge, France.
- Getta, O. (1994) *Household Energy and Demand Side Management in Ethiopia*.
- Heermans, J. (1986) *Implications for Managing Sahelian Brushland*. Working Paper at World Bank Norwegian Government 'Workshop on Desertification Control and Renewable Resources Management in the Sahelian and Sudanian Zones of West Africa', Oslo, Norway.
- Herbès, J. M., Valentin, C. and Thiéry, J. M. (1997) *La Brousse Tigrée Au Niger: Synthèse Des Connaissances Acquisés*. Chapter in 'Fonctionnement Et Gestion Des Ecosystèmes Forestiers Contractés Sahéliens. Éditions John Libbey Eurotext, Montrouge, France.
- Hosier, R. H. (1993) *Charcoal Production and Environmental Degradation*. Energy Policy Volume 21, No 5. May.
- Hoskins, M. (1979) *Community Participation in African Fuelwood Production, Transformation and Utilization*. Workshop on Fuelwood and Other Renewable Fuels in Africa, Paris. USAID and Overseas Development Council.
- Iachau, A. and Herbès, J. M. (1997) *Productivité Comparée Des Formations Structurées Et Non-Structurées Dans La Sahel Nigérien*. Chapter in 'Fonctionnement Et Gestion Des Ecosystèmes Forestiers Contractés Sahéliens. Éditions John Libbey Eurotext, Montrouge, France.
- Jackson, J. K. Et Al (1983) *Management of the Natural Forest in the Sahel Region*. USAID Forestry Support Programme, Club Du Sahel.
- Jensen, A. M. (1994) *Examen Des Politiques, Strategies, Et Programmes Du Secteur Des Energies Traditionnelles: Evaluation Des Donnés Sur Les Ressources Ligneuses Burkina Faso, Gambia, Mali, Niger, Et Sénégal*. Africa Technical Department, World Bank, Washington, D.C.
- Kerkhof, P. (1990) *Agroforestry in Africa: A Survey of Project Experience*. Panos Institute, London.
- Kerkhof, P., Siddiq, F. and Damango, B. (1998a) *Sahelian Forestry on the Crossroads of Central and Local Management*. Interim Report of Study of "Initiatives in Local

- Management of Dryland Forest Areas in the Sudano-Sahelian Zone.” Sos Sahel, London.
- Kerkhof, P., Damango, B. and Damango, G. (1998b) *Analyse Socio-Economique De Fôret De Tyi*. Draft Study Prepared for “Initiatives in Local Management of Dryland Forest Areas in the Sudano-Sahelian Zone.” Sos Sahel, London.
- Leach, G. (1992) *Farm Trees and Wood Markets: A Review and Economic Appraisal*. Pakistan Household Energy Strategy Study, Stockholm Environment Institute.
- Leach, G. and Mearns, R. (1988) *Beyond the Woodfuel Crisis: People Land and Trees in Africa*. Earthscan Publications, London.
- Madon, G. (1986) *Conservation Et Substitution De L'energie A Usage Domestique*. Projet Unso/Ner/85/Xo2, Direction De L'energie, Ministère Des Mines Et De L'energie, République Du Niger.
- Mearns, R. (1996) *When Livestock are Good for the Environment*. Working Paper 45, Institute of Development Studies, University of Sussex, England.
- Millington, A. C. Et Al (1994) *Estimating Woody Biomass in Sub-Saharan Africa*. World Bank, Washington, D.C.
- Montagne, P. Bertrand, A. and Babin, D. (1994) *Rural Markets of Wood Energy in Niger: Subsidiarity, Planning and Democracy for Viable Development*. International Conference of the International Society for Ecological Economics, San José, Costa Rica.
- De Montalembert, M. R. and Clement. J. (1983) *Fuelwood Supplies in the Developing Countries*. Forestry Paper No 42, FAO, Rome.
- Newcombe, K. (1984) *An Economic Justification For Rural Afforestation: The Case of Ethiopia*. Energy Department Paper No 16, World Bank, Washington, D.C.
- Ohler, F. M. J. (1985) *The Fuelwood Production of Wooded Savanna Fallows in the Sudan Zone of Mali*. Agroforestry Systems 3, Pp 15-23, Dordrecht, The Netherlands.
- Openshaw, K. (1997) *Malawi: Biomass Energy Strategy Study*. Background Paper for World Bank Energy Study of Malawi.
- Orgatec (1983) *Energy Survey and Master Plan*. Ministry of Economic Planning and Industrial Development, Banjul, The Gambia.
- Reddy, A. (1983) *Rural Fuelwood: Significant Relationships*. Chapter in “Woodfuel Surveys,” Forestry for Community Development Programme, FAO, Rome.
- Republique Du Senegal (1972) *Sous-Commission Publicité, Promotion Des Ventes Et Politique Des Prix*. Projet D'extension Du Marche De Butane, Ministère Des Finances Et Des Affaires Economique, République Du Sénégal.
- Ribot, J. C. (1986) *Political Economics of Charcoal in Senegal*. National Science Foundation, Research Proposal.
- Ribot, J. C. (1993) *Forestry Policy and Charcoal Production in Senegal*. Energy Policy, Vol 21, No 5.
- Ribot, J. C. (1995a) *Local Forest Access Control in Senegal: Toward Participatory Forest Policies*. Africa Regional Study, RPTES, World Bank, Washington, D.C.

- Ribot, J. C. (1995b) *Local Forestry Control in Burkina Faso, Mali, Niger, Senegal and the Gambia*. RPTES Program, World Bank, Washington, D.C.
- Steedman, C. (1979) *The Energy Situation in Senegal*. Draft Discussion Paper, Center for Research on Economic Development, University of Michigan.
- Taylor, G. F. and Soumaré, M. (1983) *Strategies for Forest Development in the Semi-Arid Tropics: Lessons from the Sahel*. International Symposium on Strategies and Designs for Reforestation, Afforestation and Tree Planting. Agricultural University, Wageningen, The Netherlands.
- Trans Energ (1984) *Republique Du Mali: Planification De L'energie: Synthese*. Paris.
- Trans Energ (1985) *Republique Du Mali: Planification De L'energie: Annexe Iii Bois Et Charbon De Bois*. Paris.
- Weber, F. (1986) Personal Comm.
- World Bank (1983) *Senegal: Issues and Options in the Energy Sector*. ESMAP, World Bank, Washington, D.C.
- World Bank (1991) *Burkina Faso; Urban Household Energy Strategy*. ESMAP, World Bank, Washington, D.C.
- World Bank (1995) *Ethiopia; Energy Assessment*. ESMAP, World Bank, Washington, D.C.
- World Bank (1997) *Republic of Senegal: Sustainable and Participatory Energy Management Project*. Staff Appraisal Report, Africa Region, World Bank, Washington, D.C.



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