THE WORLD BANK

ENVIRONMENTAL CRISIS OR SUSTAINABLE DEVELOPMENT OPPORTUNITY?

Transforming the charcoal sector in Tanzania

A Policy Note

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March 2009


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ABBREVIATIONS

BAU	Business as usual
CBFM	Community-Based Forest Management
CHAPOSA	Charcoal Potential in Southern Africa
DoE	Division of Environment
ESD	Energy for Sustainable Development
FAO	Food and Agriculture Organization
FBD	Forest and Beekeeping Division
FS	Fuel switch
GDP	Gross Domestic Product
GoT	Government of Tanzania
HH	Household
IK	Improved kiln
IS	Improved stove
JFM	Joint Forest Management
LPG	Liquefied Petroleum Gas
MEM	Ministry of Energy and Minerals
MoFEA	Ministry of Finance and Economic Affairs
MNRT	Ministry of Natural Resources and Tourism
NGO	Nongovernmental organization
NRM	Natural Resources Management
PFM	Participatory Forest Management
PMO-RALG	Prime Minister's Office – Regional Administration and Local Government
REDD	Reducing Emissions from Deforestation and Forest Degradation
RPTES	Regional Program for the Traditional Energy Sector
RWEDP	Regional Wood Energy Development Programme
TaTEDO	Tanzania Traditional Energy Development and Environment Organization
TANROADS	Tanzania National Roads Agency
TOF	Trees outside forests
TShs	Tanzania Shillings
USAID	United States Agency for International Development
VAT	Value Added Tax
VPO	Vice President's Office

Unless otherwise stated, all dollars are US Dollars and all tons are metric tons
1 US Dollar = 1,378 TShs (March 31, 2009)

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The analysis and recommendations presented in this policy note took advantage of the experience and input of a large number of people involved in the charcoal sector, both inside and outside Tanzania. The World Bank wishes to express its great appreciation to the many people in Tanzania who offered information, ideas, comments, and critical points of view over the course of developing this policy note. In particular, we wish to thank the government of Tanzania for providing leadership in the overall process. The team is particularly grateful to Dr. Felician Kilahama (Director, Forestry and Beekeeping Division, Ministry of Natural Resources and Tourism), and Mr. Ngosi Mwihava (Assistant Commissioner, Renewable Energy, Ministry of Energy and Minerals), as well as their respective staff.

Furthermore, this policy note benefitted from four stakeholder workshops organized by the Ministry of Natural Resources and Tourism (MNRT) together with the World Bank in Dar es Salaam between October 27 and 30, 2008. The purpose of these workshops was to discuss and agree upon specific policy measures with relevant stakeholders, including charcoal producers, traders, district officials, representatives from different sector ministries (MNRT, Ministry of Energy and Minerals), NGOs, and development partners. These consultations would have not been possible without the assistance of Francis Songela (Camco Advisory Services Ltd.), Felix Mallya (Consultant), and Faith-Lucy Matumbo (World Bank Office, Tanzania).

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EXECUTIVE SUMMARY

An estimated 90 percent of Tanzania's energy needs are satisfied through the use of wood fuels. Charcoal is the single largest source of household energy in urban areas, as it is considered cheap and easy to transport, distribute, and store. Between 2001 and 2007, the proportion of households in Dar es Salaam using charcoal climbed from 47 percent to 71 percent. Approximately half of Tanzania's annual consumption of charcoal takes place in Dar es Salaam amounting to approximately 500,000 tons.

The amount of charcoal consumed is expected to further rise in the coming years. Signs indicate consumption levels will be increasing in both absolute and relative terms in the near and medium term future due to three main factors: (a) rapid population growth; (b) continued urbanization; and (c) relative price increases of fossil fuel-based alternative energy sources. These trends will apply particularly to the urban center of Dar es Salaam. Due to income constraints, switching to alternative fuels will only be an option for better-off households, but even among those economic groups, socio-cultural aspects will still result in the consumption of charcoal, albeit it at a lower level. The International Energy Agency (IEA) confirms similar trends are occurring in other Sub-Saharan African countries. Considering this, the charcoal sector must become sustainable and formalized as a business.

At present, the contribution of Tanzania's charcoal sector to employment, rural livelihoods, and the wider economy is estimated to be in the region of US$650 million per year, providing income to several hundred thousand people in both urban and rural areas. These tend to be members of poorer households, who work as small-scale producers or traders, and who often have limited alternatives for earning a living. Despite the important role charcoal plays in local economic development, its contribution to government revenues and the broader tax base is limited due to widespread evasion of licensing fees and transport levies. National and local governments are estimated to lose about US$100 million per year due to their failure to effectively regulate the charcoal sector.

The charcoal trade is characterized by very weak governance, law enforcement, and other regulatory capacity. Low capacity to enforce regulations and effectively collect revenues is further undermined by corruption at checkpoints along charcoal transport routes. The charcoal trade is dominated by a small number of powerful and politically connected entrepreneurs who are able to use their influence to further avoid and evade payments of fees and obtaining of licenses. The tight control of the sector by a small number of people has two important implications. First, it means that efforts to reform and regularize the sector will be intensely resisted and will require significant political support. Second, it means that the bulk of charcoal profits are concentrated within a narrow band along the production-marketing chain. Producers, small-scale transporters, and retailers (who far outnumber more powerful wholesalers and transporters) receive a very small share of the final market price. This provides a strong disincentive toward sustainable forest management and afforestation and reforestation investments by charcoal producers.

Charcoal is generally unsustainably harvested from dry (or miombo) woodlands within a catchment area that extends up to 200 kilometers from urban energy markets. Although some wood for charcoal is harvested from forest reserves under license from the government, the bulk is harvested in unreserved forest areas on village land, or on farmland being cleared for agriculture. In such situations, little attention is given to considerations of sustainable harvesting or longer-term forest management objectives. Continual, unregulated tree removal results in deforestation and forest degradation; this, in turn, has negative impacts on the protection of water catchments and watersheds, affecting energy and water supplies alike.

Given that most charcoal is harvested without any payments being made for the raw material (wood), and that licenses and levies are largely evaded, the cost of charcoal to the consumer does not reflect its real value. The impact of these lower costs is to undermine any efforts made by producers or traders to comply with the law by paying all licenses and levies, or to invest in efficiency savings such as improved conversion technology, long-term sustainable forest management, or establishment of plantations and woodlots. Without improving the regulatory and fiscal frameworks of the sector, the market price of legal and sustainably produced charcoal will always be undercut by unregulated and unsustainable products.

Significant changes need to be introduced to regularize and legalize the currently informal sector. This would require a major shift both inside and outside government with regard to how charcoal is viewed and managed from a policy perspective. Currently, the sector is viewed almost entirely negatively, and as a result, prevailing policies and laws tend to focus on regulation, enforcement, restriction, and, where possible, moving away from the sector altogether to other energy sources. This policy note argues that this perception will need to be changed, and instead a more enabling environment created that allows for

responsible, sustainable, and profitable enterprises to flourish within the sector. This policy note provides recommendations that, if implemented, would lead to an increased formalization of the charcoal sector, changing the regulatory, fiscal, and pricing frameworks. These include:

- **Ensuring that charcoal revenue collection responsibilities of local governments are matched with an ability to retain a higher share of revenue collected.** To achieve this, it is proposed that the Ministry of Natural Resources and Tourism (MNRT), together with the Prime Minister's Office–Regional Administration and Local Government (PMO-RALG), and the Ministry of Finance and Economic Affairs (MoFEA) identify pilot districts with the commitment and political will to reform charcoal trade. These districts would be allowed to retain charcoal revenues (licenses and fines) levied on areas outside forest reserves. Retained revenues would provide financial and human resources for the regulation and management of the charcoal sector. Subsequently, this would expand the revenue base of the districts, improve monitoring and control of the charcoal sector, and ultimately reduce unsustainably produced charcoal. These pilots would be closely monitored and, if found successful, the approach should be replicated.

- **Supporting local governments in reinvesting charcoal income, with the objective to further improve revenue collection and promote sustainable forest management.** Most of the limited internal revenue of local governments is being invested in priority areas such as infrastructure, education, and health. Therefore, the current system of "earmarking" grant funds continues to be critical in the short to mid term, as it provides an incentive for local governments to invest in the charcoal sector. However, taking into account the potential a regulated charcoal sector has in contributing to district and village budgets, after a grace period of three years (and the better integration of the forest and charcoal sectors into village and district development plans), a significant portion of revenue collected from charcoal should be reinvested in support for the sector. Examples of similar models already exist in Tanzania, such as the Road Fund, which comes from a levy charged on fuel costs, and is reinvested into the construction and maintenance of roads.

- **Introducing fiscal incentives that reward sustainably produced charcoal and place additional costs on that which is illegally produced.** To offset the increased investment costs associated with sustainably produced charcoal, it is proposed that a fiscal incentive scheme be developed. This scheme would introduce reduced licensing costs for charcoal coming from areas with an approved harvesting plan. At the same time, tougher sanctions could be introduced for illegally produced or traded charcoal. Ultimately, this would make sustainably produced charcoal able to compete with illegal charcoal as the cost for the consumer would become progressively aligned, allowing to compete openly and in a profitable manner. If effective over time, the relative proportion of charcoal traded officially and formally would grow, and illegally produced charcoal would decline. Over time, these incentives should be progressively reduced. This would require the collaboration of the MNRT, PMO-RALG, and MoFEA to agree on the approach and development of a feasible incentive system.

- **For the system to be successful, the government would need to strengthen its capacity for monitoring and enforcement of rules and regulations regarding both transport and trade of charcoal.** Aside from increasing the efforts to strengthen the capacity of the Forest Surveillance Units (FSUs) under the MNRT, it would be necessary to improve collaboration with other enforcement agencies. Charcoal should also be an integrated part of the Independent Forest Monitoring currently under development. In addition, it is proposed that the increase of human resources for monitoring and control be complemented by investment into critical infrastructure such as: (a) building fixed trading sites for the transport and trade of charcoal in urban areas, as well as (b) increasing the number and effectiveness of checkpoints. These investments would, if closely coordinated with the Tanzania National Roads Agency (TANROADS), improve not only the revenue collection system, but also provide important information regarding the dimension of the charcoal sector.

Given the current political economy of charcoal in the country, bringing the charcoal trade into the tax-based economy is a significant challenge, that needs to be tackled head-on and would require strong political support if the vested and powerful interests that currently control the sector are to be confronted. Furthermore, as reforms gather pace, increasing amounts of traded charcoal would enter the formal economy reflecting the true costs of production (including raw material costs, and all fees and taxes). As a result, the end price to consumers is expected to rise.

Raising prices of sustainably produced charcoal have opportunities, but require the introduction of efficiency measures at the consumption level. As in any country, rising fuel prices are strongly opposed, and this would again be a politically challenging consequence of reform of the production and consumption segments of the charcoal value chain. However, the rising price of charcoal would create two important opportunities. First, it would provide a more favorable environment for small-scale entrepreneurs to invest in efficient production and conversion measures, such as tree planting, participatory forest management, and improved kilns. Second, it would deliver greater incentives to consumers to invest in simple technology (such as improved stoves) designed to reduce charcoal consumption, and hence cost. An increased demand for energy-saving technology would also act as a powerful stimulus for urban entrepreneurs to develop and market energy-efficient stoves. Supporting measures are proposed that would reinforce moves to make the charcoal sector more sustainable, inclusive, and achieve greater impacts on poverty reduction, if implemented alongside the policy reforms mentioned above. These are as follows.

- **Harvesting plans need to be developed for forest areas administered by central or local governments.** Taking into account the lack of reliable data on forest resources available in Tanzania, harvesting and licensing decisions are currently driven by inaccurate estimates of standing stock or resource availability. To address this issue and move toward a sustainable charcoal sector, it will be critical that more accurate assessments are undertaken. The currently planned National Forest Resource Assessment is expected to provide some relevant data, yet it must be a priority for the MNRT to undertake more local assessments. Once assessments are made and harvesting plans are implemented, it is crucial that compliance with harvesting plans is monitored by local governments and harvesting committees.

- **Scaling up community-based forest management (CBFM) will help secure tenure for rural producers.** The most devolved form of participatory forest management (PFM)—community-based forest management—offers communities the opportunity to declare forest reserves on village lands, which are managed in line with local development priorities. If communities are to become involved in meeting the demands of the charcoal trade from village forests, efforts need to be directed in a more concentrated and targeted manner at remaining unreserved natural forest and woodland patches across the districts neighboring large urban charcoal markets (such as those surrounding Dar es Salaam). While this would require continuous engagement from external sources, as establishing CBFM arrangements incur substantial initial costs, fiscal reforms proposed earlier would ultimately increase revenue collection at local government levels, which has the potential to cover CBFM support costs in the long term.

- **Small-scale plantations and woodlots could increase supplies of wood for charcoal and trigger economic opportunities and land-use planning in rural areas.** Although natural forests are expected to continue supplying much of the raw material for charcoal production, considering the projected increase in charcoal demand, natural forests will not be able to meet these demands in a sustainable manner. Consequently, the establishment of private or group-based woodlots or plantations could, in the long term, complement supplies outside forest reserves. Subsidies and incentive payments might be necessary in the early stages to trigger local-level investments in establishing planted woodlots. Complementary measures to improve the overall regulation and formalization of the charcoal sector must be introduced to gradually replace subsidies with more market-based credit provision in the medium to long term. As farmers begin to secure financial benefits from the sale of wood for charcoal, it is likely that other farmers would engage in similar activities. In this context, the potential carbon-finance opportunities need to be further explored.

- **Effective pricing policies of raw material by charcoal producers could provide an incentive to adopt technologies improving the efficiency of charcoal production.** Considering that the raw material has no cost, charcoal producers currently have no incentive to invest in more efficient technologies. When raw materials carry a price, i.e. investment costs for sustainable forest management or plantation establishment, producers would be provided with an incentive to invest in relatively simple though effective technologies that improve the efficiency of turning wood into charcoal. While semi-industrial charcoal kilns may achieve significant efficiencies, they may only be a viable option for large-scale production enterprises. However, small-scale producers should be provided with simple training on how efficiencies of traditional charcoal production (earth kilns) can be improved. Using the experiences gained by local NGOs (such as the Tanzania Traditional Energy Development Organization (TaTEDO)) in this regard may prove to be a useful option. These efficiency improvements would help producers offset initial investments costs.

- **The promotion of fuel-efficient stoves can compensate for expected increases in sustainable charcoal prices.** With charcoal prices likely to increase as fiscal incentives are implemented that favor sustainably produced charcoal, fuel-efficient stoves must be further promoted in order to compensate for increased consumer prices. By improving the availability of high-quality, fuel-efficient stoves, consumers would have the possibility to offset increased charcoal prices. However, price premiums on fuel-efficient stoves need to be smaller than the monetary savings expected through reduced charcoal quantities in order to provide a true incentive.

- **Fuel switching, targeted at better-off segments of the society, must be an integral part of policy measures to achieve sustainable charcoal production.** Fuel switching will not be economically feasible for most parts of urban society due to high initial investment costs and other economic constraints, such as unreliable and fluctuating income streams. In contrast, policies promoting fuel switching need to be further strengthened when targeted at better-off households. These households have the means to switch to a wider portfolio of fuel sources, and the use of gas and electricity for some specific purposes (e.g. heating water for tea in the morning) could stabilize or even reduce absolute charcoal consumption quantities among certain segments of urban consumers.

In addition to the employment and income benefits the above measures would deliver, charcoal sector reform would have a number of other important impacts. One such benefit would be an increase in government revenue and a broadening of the tax base. Furthermore, if measures are introduced to improve the supply of raw materials for charcoal production (through tree planting initiatives and participatory forest management), unsustainable production would gradually be replaced by regulated production on a sustainable basis.

There is increasing interest inside and outside the Tanzanian government in climate mitigation and adaptation, and in particular Reducing Emissions from Deforestation and Forest Degradation (REDD). With charcoal being one of the main drivers of deforestation and—to some extent—degradation, measures outlined in this policy note would benefit from this additional financing, particularly around urban centers such as Dar es Salaam. For charcoal sector reform, the following considerations for promoting stakeholder participation at the local level, currently discussed under REDD initiatives, are of relevance: (a) strengthening rights and governance through implementation of forest tenure reforms, mapping of lands, and recognition of rights to ecosystem services in support to the ongoing expansion of participatory forest management; (b) providing necessary incentives for tree planting, woodlot establishment, and technologies improving the efficiency of charcoal production; and (c) using REDD funding to develop stronger accountability structures, inclusive processes that engage a multitude of stakeholders, and monitoring and control systems at the local level.

CHAPTER 1 INTRODUCTION

THE CHARCOAL SECTOR—SUMMARY OF ISSUES

Wood fuels (firewood and charcoal) are the most important energy source in Tanzania. The 2007 Tanzanian Household Budget Survey indicates that 90 percent of the country's energy needs are satisfied through the use of wood fuels. Despite increasing investments in improving access to electricity and other energy sources, the proportion of households in the country using charcoal for cooking has increased by 7 percent since 2001. In urban areas such as Dar es Salaam, the figure is much higher (box 1.1).

BOX 1.1 FIVE FACTS ABOUT CHARCOAL PRODUCTION AND UTILIZATION IN TANZANIA

1. National Economy: The total annual revenue generated by the charcoal sector for Dar es Salaam alone is estimated at US$350 million, and generates employment and cash income for several hundred thousand people. Coffee and tea are estimated to contribute only US$60 million and US$45 million to the national economy, respectively. Foreign direct investment for Tanzania was estimated at US$470 million in 2004.

2. Revenues: Unregulated and unregistered activities in charcoal production and utilization lead to an estimated revenue loss of about US$100 million per year. The Forestry and Beekeeping Division (FBD) of the Ministry of Natural Resources and Tourism (MNRT) has a financing gap between expenditures and revenues of about US$2 million.

3. Cooking Behavior: From 2001 to 2007, the proportion of households in Dar es Salaam using charcoal as their primary energy source has increased from 47 percent to 71 percent. Use of liquefied petroleum gas (LPG) has declined from 43 percent to 12 percent. In other urban areas, the share of households using charcoal for cooking remained at 53 percent, while the share of fuelwood use increased from 33 percent to 38 percent. The use of electricity for cooking is below 1 percent.

4. Charcoal Production: Total annual charcoal consumption in Tanzania is estimated at 1 million tons. The annual supply of wood needed for this is estimated at 30 million cubic meters. To produce charcoal it is estimated that as many as 160,000 earth kilns are used each year, or 438 per day. An average annual loss of forest area of about 100,000–125,000 hectares can be attributed to the charcoal sector.

5. Urbanization: The share of the urban population was 33 percent in 2007 (up from 21 percent in 2001). With a growth rate of 4.3 percent per year, Dar es Salaam is one of the fastest-growing cities in Sub-Saharan Africa. In 2005, the population was estimated at 3 million. Meanwhile, 36 percent of Tanzania's total population lives below the poverty line, 44 percent of the population is below the age of 15, and life expectancy at birth is only 52 years. One study estimates that a 1 percent increase in urbanization leads to a 14 percent increase in charcoal consumption.

Sources: Tanzania at a Glance 2008; Beukering et al 2007; MNRT 2002, 2004; 2007 Tanzanian Household Budget Survey (2008); Hosier 1993; World Resources Institute/Earth Trends 2003.

The demand for charcoal is expected to increase for the following reasons.

- With an estimated population increase of 2 percent to 3 percent per year, Tanzania's population will double in about 20 to 25 years.
- Tanzania will become increasingly urban, as people continue to flock from the countryside to urban centers in search of jobs and a better standard of living. Increasing urbanization will lead to increasing demand for charcoal.
- Rising prices for alternative fuels such as LPG, natural gas, or electricity also cause people to continue using charcoal, despite rising incomes.

Harvesting wood to produce charcoal is currently very poorly regulated. It takes place inside and outside government forest reserves, as well as on open-access public lands. Given the massive demand for charcoal in Dar es Salaam, pressure on natural woodlands and forests within 200 kilometers of the capital is high, and rates of deforestation and degradation are increasing. Deforestation (particularly around watersheds and water sources) has further knock-on effects due to reduced water flows and subsequent interrupted power generation in hydroelectric schemes such as Mtera and Kihansi. The economic costs associated with unreliable power supply have been estimated at about US$330 million for 2006 representing about 2 percent of GDP (World Bank 2006). Lost revenue to the government (such as reduced collection of value added tax on electricity consumption) was further estimated at about US$3 million that year. At the international level, continuing unsustainable charcoal production undermines the country's efforts to meet its objectives for participating in international initiatives designed to combat climate change, such as Reducing Emissions from Deforestation and Forest Degradation (REDD).

Much of the potential revenue payable to the government from effective taxation of charcoal production and trade is lost due to the sector's informal nature, as well as the poor governance and regulation in the forest sector. Lost revenue to the government, as a consequence of ineffective revenue collection, is estimated to be in the region of US$100 million per year. Despite this massive undercollection, charcoal continues to play an important role in the national economy— particularly in its role providing employment to hundreds of thousands of people. Charcoal is also especially important as a means of generating income for some of the poorest members of society, for whom alternative options are severely limited. Given that much of the production and trade in charcoal is conducted in an illegal or clandestine manner, its potential to provide a secure and stable income is limited. The informal nature of the sector drives "short-termism" and results in overexploitation of the resource, as well as an unwillingness to invest in more efficient production or conversion techniques.

As charcoal is largely a "hidden" sector, its role in the national economy is almost always overlooked, and as a result its actual and potential contribution to economic development is systematically underestimated. Nowhere is this omission more striking than in the national energy strategy, which completely overlooks charcoal and firewood, despite the fact that it provides energy for around 90 percent of the country's population.

In summary, the use of charcoal is very likely to continue at a rather high level in the near to medium term. Rather than ignoring this fact, a more proactive and development-oriented involvement by all stakeholders with this sector is needed. The charcoal sector is currently characterized by unsustainable forest management, significant revenue losses for the national economy, and lost opportunities for employment and income generation for poorer members of society. However, a well-managed charcoal sector has the potential to boost government revenues, create incentives for long-term and sustainable forest management, and provide secure and attractive incomes to rural and urban entrepreneurs.

OBJECTIVES OF THE POLICY NOTE

In light of the challenges described above and in box 1.1, the Government of Tanzania (GoT) asked the World Bank to provide decision makers in Tanzania with a policy note summarizing the fundamental characteristics of charcoal use in the country and presenting policy options along the entire value chain of charcoal production and consumption.

With the understanding that charcoal consumption is expected to continue at relatively high levels in the near and medium term, the policy note identifies the underlying factors behind the charcoal sector that are driving deforestation, as well as resulting in lost revenues to the national economy and individual traders and producers. Based on this analysis, the objectives of this policy note are to identify a number of policy options, which if implemented together, will result in:

- sustainable and long-term management of forest and woodland resources;
- sustainable supply of energy, especially to the urban poor;
- increased revenue capture by the government from the charcoal sector as a whole;
- greater security and increased incomes for small-scale charcoal producers and traders.

This policy note will serve as an input to the development of a Woodfuel Action Plan, which is currently under preparation by the GoT and should be available in mid-2009. The Woodfuel Action Plan is in turn intended to inform the review of the Energy Strategy for Tanzania.

METHODS USED IN PREPARING THIS POLICY NOTE

The policy note builds on experience from both Tanzania and other Sub-Saharan African countries with similar socioeconomic and environmental contexts. This policy note puts forward and discusses a range of policy measures along the entire charcoal value chain in Tanzania. The development of this policy note benefited from a variety of recent studies on charcoal utilization and trade conducted in the country.

One of the aims of this policy note is to review and consolidate the findings and conclusions of these various reports and translate them into practical policy advice for the government of Tanzania. Given the many studies undertaken in both Tanzania and across Sub-Saharan Africa relating to the charcoal problem, no specific primary data collection or research was conducted to guide this policy note. Instead, the emphasis has been placed on reviewing successful experiences elsewhere, and assessing how these successes might be replicated in a Tanzanian context.

A simple bio-economic model has been developed to model charcoal supply and demand, and to assess how different policy options might have varying impacts on forest management. It should be noted that this model is intended to provide general guidance, rather than generate an accurate forecast of future charcoal supplies and demand. A detailed description of the model is provided in annex 2, while the results of various simulations are presented in annex 3.

This policy note reflects outcomes of four stakeholder workshops the Ministry of Natural Resources and Tourism (MNRT) organized together with the World Bank in Dar es Salaam between October 27 and October 30, 2008. The purpose of the workshops was to discuss specific policy measures with relevant stakeholders, including charcoal producers, traders, district officials, representatives from different ministries (MNRT and Ministry of Energy and Minerals (MEM)), NGOs, and development partners.

The remainder of this policy note is structured as follows: Chapter 2 provides a broad overview of the charcoal sector in Tanzania and some of the key challenges being faced. It also includes a summary of the key legal and policy measures that have been taken over the past two decades and an assessment of how successful they have been in effecting positive change. Following this, chapter 3 summarizes experiences reforming the charcoal sector in Tanzania and elsewhere, as well as an assessment of how successful these measures have been. Where possible, key lessons learned are extracted and used to inform policy recommendations. In chapter 4, key policy recommendations are made along the production and marketing chain, which are hoped will provide a useful resource for policy makers and implementers. Chapter 5 assesses the likely impact of the reforms on reducing deforestation and forest degradation, as well as the positive impacts on boosting employment and improving rural livelihoods. The chapter concludes with an assessment of the costs of the policy recommendations made.

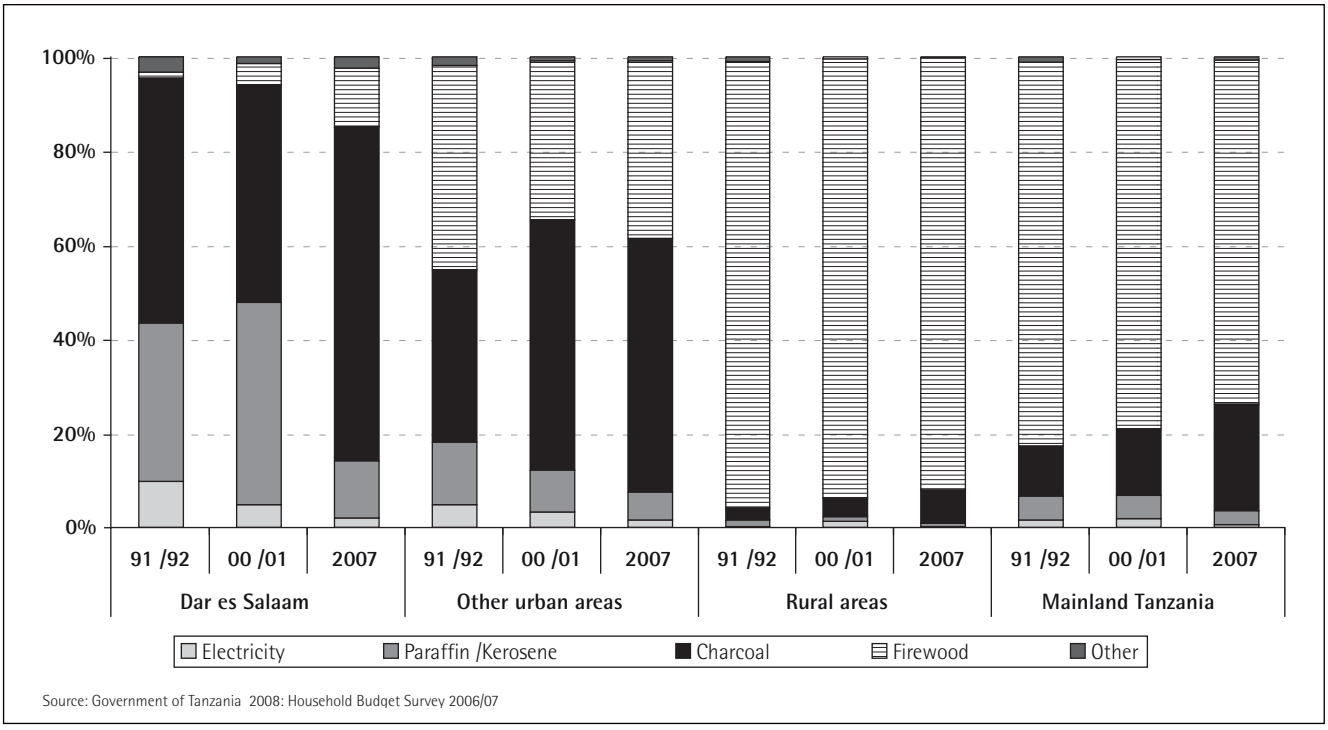
CHAPTER 2 THE CHARCOAL SECTOR IN TANZANIA – AN OVERVIEW

SOCIOECONOMIC CONSIDERATIONS

Charcoal Use and Consumption Patterns

Charcoal is the main energy source for Tanzania's urban population. Although electricity and gas are the principal energy sources among wealthier households, these households still use considerable quantities of charcoal. Most public and private urban institutions in Tanzania (such as bars, restaurants, schools, and hospitals) also use significant quantities of charcoal as their principal source of energy for cooking. Across the whole country, only 10 percent of the population uses electricity as their primary energy source. Household energy use patterns over the recent years are presented below in figure 2.1.

FIGURE 2.1 SOURCES OF ENERGY FOR COOKING IN TANZANIA, 1991 TO 2007



Source: Government of Tanzania 2008: Household Budget Survey 2006/07

The total proportion of disposable income spent by poorer households on charcoal is much higher than for richer households. Furthermore, richer households are able to buy charcoal in bulk, where unit prices are significantly lower than for smaller quantities. As a result of their limited cash flow and low purchasing power, poorer households buy charcoal more frequently and in much smaller quantities, but at a much higher unit price.

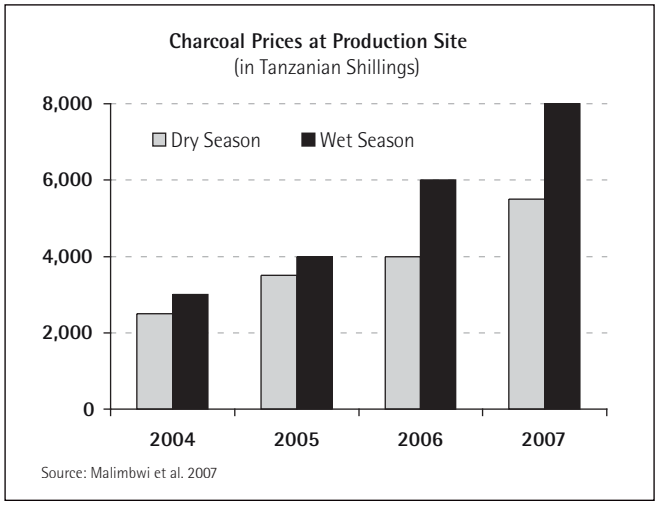
Fuel use is closely related to income and education level. A recent household survey conducted in Dar es Salaam by Palmula and Beaudin (2007) indicates that users of firewood have the lowest income level, with 80 percent living on less than US$77 per month. Charcoal and kerosene consumers are generally lower-middle-income households, and users of LPG have the highest income level, with more than 90 percent of those households earning over US$155 per month. Electricity users appear to have higher income levels than firewood, charcoal, and kerosene users, but electricity is also used more often than LPG in lower-income families.

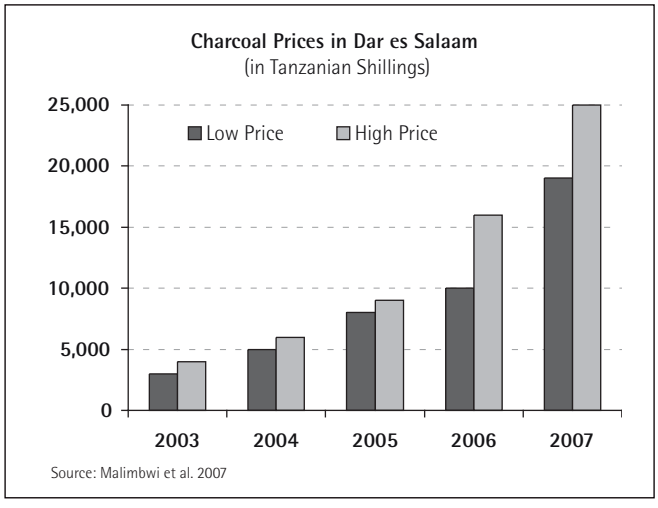
Firewood users are characterized by the lowest education level, with nearly 80 percent having no education or having completed only primary school. Charcoal and kerosene users have similar educational profiles, with most people having completed at least secondary school. However, 13 percent of charcoal users have a university degree, indicating that charcoal is often used as part of a mix of energy sources, even when it is used for the same purpose, such as cooking. In a survey among 700 households in Dar es Salaam, Charcoal Potential in Southern African or CHAPOSA (2002) observed that 88 percent of households use more than one energy source, while the remaining 12 percent combine more than two energy sources for domestic use.

According to the survey, the perceived low cost of charcoal is one of the main reasons for its use. Second, widespread availability, is also important for more than half of the respondents. The majority of users tend to buy charcoal several times a week in small quantities from traders that are located only a few minutes from their house. This is confirmed by the CHAPOSA report (2002), which found that 36 percent of charcoal users in Dar es Salaam obtain charcoal from a variety of charcoal stores located near their homes, while 26 percent buy from local kiosks that also sell other items, such as vegetables and other foods. In addition, 24 percent buy charcoal from larger retailers, while only 12 percent buy from larger roadside retailers. Only 1 percent of users obtain supplies outside the city. CHAPOSA (2002) also observed that charcoal is easily accessible. For 67 percent of respondents, it takes between one and five minutes to get to a selling point, for 21 percent it takes six to 10 minutes, and for 12 percent it requires between 15 and 60 minutes. Those needing between one and five minutes generally buy in very small quantities, such as in small tins or heaps.

Between 2004 and 2007, charcoal prices in Dar es Salaam increased rapidly. At production sites, charcoal prices increased by 160 percent, from around TShs 3,000 per bag[1] to TShs 8,000 per bag. Even more dramatically, the retail price of charcoal in Dar es Salaam has increased from below TShs 5,000 in 2003, to over TShs 20,000 in 2007. By late 2008, retail prices had risen further, to over TShs 25,000 per bag. During the same period, global prices for fossil fuels rose sharply, and in some cases, supplies of kerosene and LPG were interrupted. As illustrated in figure 2.1, in some cases this meant that some households moved back to charcoal as their primary energy source.

FIGURE 2.2 CHARCOAL PRICES AT PRODUCTION SITES (2004–07) AND IN DAR ES SALAAM (2003–07)





[1] While the legal weight for a charcoal bag is defined as 28 kilograms, the weight of charcoal bags sold in the market place is higher and can go up to 120 kilograms.

Charcoal Sector Contribution to Rural Employment and Income

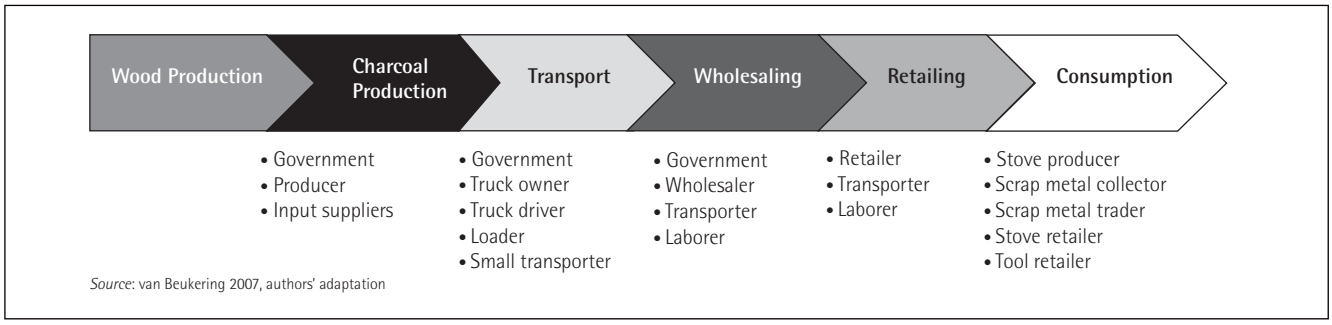
As in many other Sub-Saharan countries[2], several tens of thousands of rural and urban entrepreneurs in Tanzania earn vital income from charcoal production and trade. Production in the Tanzanian charcoal industry is estimated at about 1 million tons per year. In financial terms, the value of the entire Tanzania charcoal sector is valued at US$650 million. Figure 2.3 illustrates the wide range of beneficiaries along the charcoal value chain, without taking into account more indirect benefits, such as the sale of diesel to trucks transporting charcoal, the sale and repair of tools necessary for tree felling and kiln preparation, or even the use of mobile phones for communication between different actors. Government is mentioned where royalties, license fees, or taxes are charged. Further indirect effects such as employment for government officials or taxes charged on other products (such as stoves), are not considered.

The Charcoal Trade

As illustrated in figure 2.3, the structure of the charcoal chain is complex, comprising many different actors with varying interests and stakes. The vast majority of charcoal comes from natural forests. Plantations, woodlots, or trees outside forests (such as in agroforestry systems, along roads, and around fields) play only a negligible role in supplying raw material for charcoal production[3]. Charcoal producers are often contracted by wholesalers or transporters, but they also work and sell their products individually.

A limited number of people consider charcoal production to be their main economic activity, while a majority engage only occasionally as a means to generate income, particularly in times of financial stress, such as when making large payments for things such as medical costs, funeral expenses, food supplies in the event of poor harvests, marriage ceremonies, or school fees. The majority of charcoal is sold to large- or small-scale transporters. Some large-scale transporters are also wholesalers. These wholesalers then pass the charcoal on to smaller-scale retailers and consumers. Trade in charcoal is conducted by formal as well as informal actors. One commercialization chain begins with government-issued licenses for harvesting of wood to produce charcoal. The product is transported and traded by officially licensed transporters and traders, who pay the necessary duties and taxes. A second, and larger, commercialization chain is undertaken without official licensing. Charcoal produced through this informal chain is transported and traded clandestinely in an attempt to avoid authorities, taxation, and potential penalties. Nearly 80 percent of the charcoal arriving in Dar es Salaam is believed to follow this second path (Malimbwi et al. 2007). With the value of Tanzania's charcoal business conservatively estimated at about US$650 million, this represents unregulated trade of around US$500 million per year. The potential annual taxes and levies lost from this represent around 20 percent of its total value, or around US$100 million

FIGURE 2.3 BENEFICIARIES IN THE CHARCOAL VALUE CHAIN IN TANZANIA



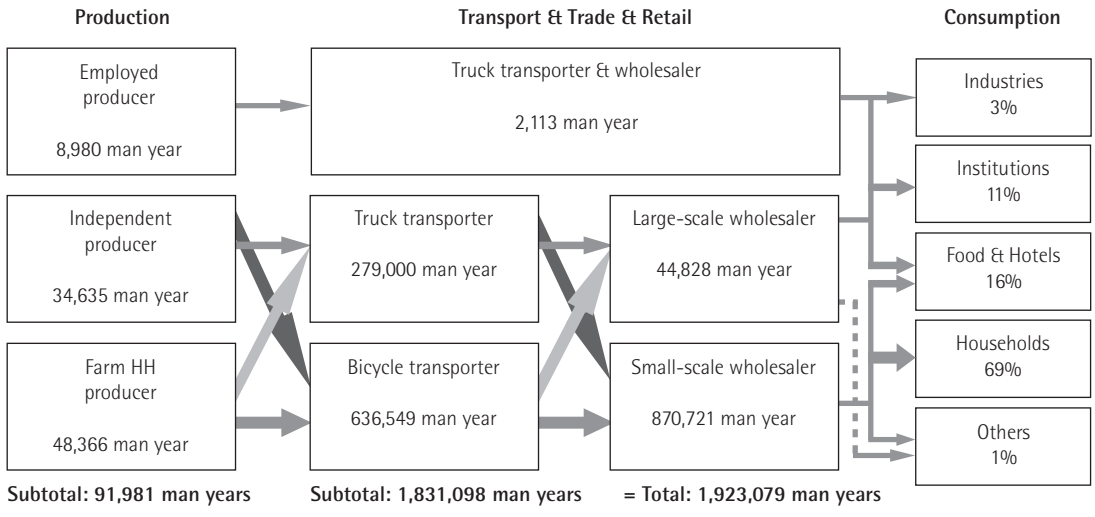
Source: van Beukering 2007, authors' adaptation

The formal, regulated charcoal trade involves a number of direct and indirect costs that are avoided through the informal trade—particularly in terms of costs related to licenses and fees. Even though unreserved forests in Tanzania are de jure owned and managed by the government, lack of management capacity makes them de facto open-access resources. Trees are often harvested from open areas at no cost to the producer. In addition, government royalties and fees are often lower than the true opportunity cost of the resource. These factors lead to an underpricing of the resource and reduce incentives for investments in sustainable charcoal production or trade, either by the government or private entrepreneurs.

[2] Kambewa et al. (2007) estimate employment for about 93,000 people in the charcoal industry in Malawi.

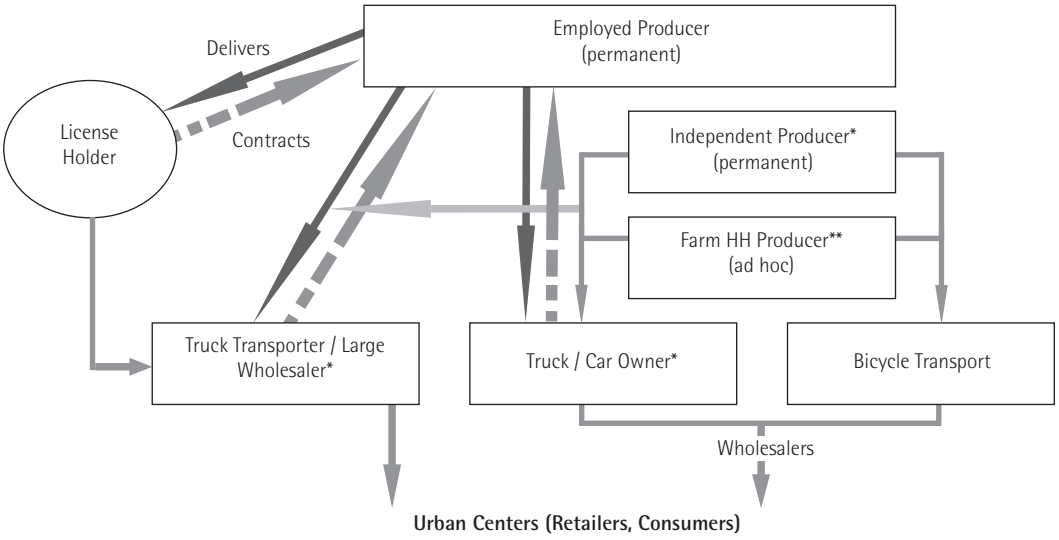
[3] These resources tend to be prioritized for other uses such as firewood, poles, or timber.

FIGURE 2.4 CHARCOAL TRADE EMPLOYMENT AND CONSUMPTION ESTIMATES IN TANZANIA[1]



Source: van Beukering et al. 2007; authors' adaptations

FIGURE 2.5 STRUCTURE OF FOREST EXPLOITATION FOR CHARCOAL PRODUCTION AND TRADE



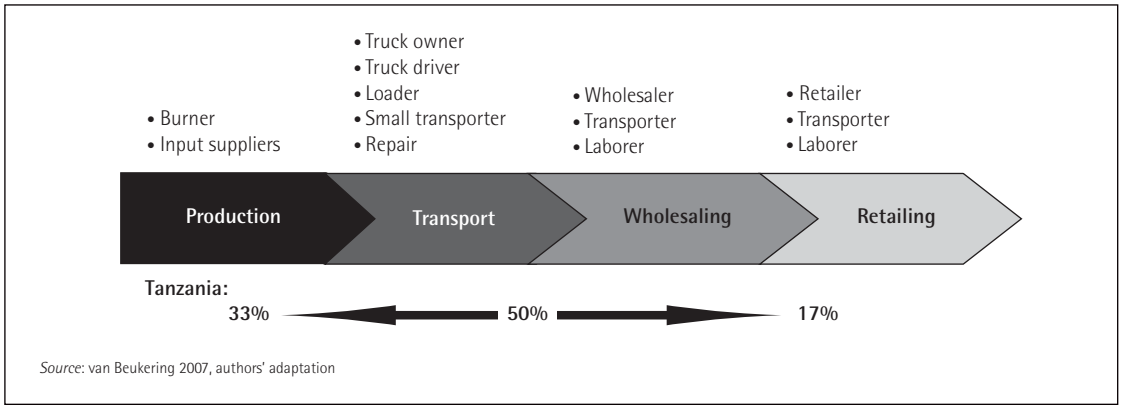
* may have a license to transport charcoal; there is evidence that often does not have a license
** generally does not have a license

Source: Authors' discussion with stakeholders

[1] A man year is a method of describing the amount of work done by an individual throughout the entire year. The man year takes the number of hours worked by an individual during the week and multiplies it by 52 (or the number of weeks worked in a year). The man year calculated will be different for various industries depending on the average number of hours worked each week and the number of weeks worked per year.

Despite the involvement of a great number of people in the charcoal trade, profits are usually concentrated in the hands of a few intermediaries, mainly engaged as transport agents or wholesalers. Retailers in urban centers—often women— receive a very small share of the final market price, while producers receive similarly small benefits. Communities whose forest areas are being harvested may receive no benefits whatsoever, as wood is generally harvested illegally or without direct payment. The concentration of benefits in the hands of a few is often reinforced by political elites, who use their power as a means to efficiently circumvent legal fees and levies. Looking across the whole value chain, on average, producers are able to capture around one-third of the final end price of charcoal, with transporters and wholesalers capturing around half (figure 2.6)

FIGURE 2.6 DISTRIBUTION OF PROFITS ALONG THE CHARCOAL VALUE CHAIN



Source: van Beukering 2007, authors' adaptation

The failure of producers to capture a larger share of the market price may be due to several reasons: (a) the supply of unskilled labor is large; (b) independent producers are not organized and, thus, cannot exercise any negotiation power; and (c) transport and large-scale wholesaling is organized by cartel- or monopolistic-type market structures. At the same time, retailers are not organized and lack market influence. The reason that producers and retailers are unable to organize in interest groups or cooperatives is largely due to the fact that many operate illegally. There is anecdotal evidence that public sector employees and authorities are commonly believed to be dominant actors in the illegal transport and trade of charcoal.

IMPACT OF THE CHARCOAL TRADE ON FORESTS AND WOODLANDS

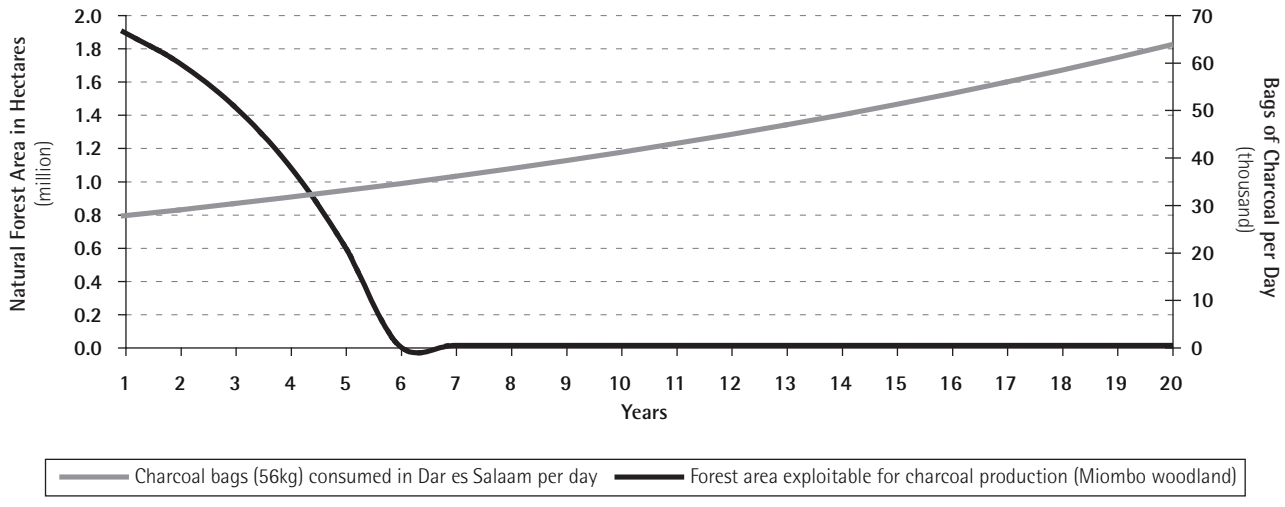
In total, Tanzanians consume more than 2,650 metric tons of charcoal each day or roughly 1 million tons per year. To produce that quantity using traditional methods, the daily wood requirement would be equivalent to that contained in 342.5 hectares of forest[4]. A full year of this consumption would equate to more than 125,000 hectares of forest destroyed, or 12 square kilometers[5]. This figure should be treated with some caution, however, as wood harvesting for charcoal most often is opportunistic, resulting in a gradual degradation of forest resources over time, rather than clear-cutting over a large area, leading to real deforestation. Furthermore, the production of charcoal is often a byproduct of other economic activities, such as the clearance of land for agriculture. A common practice when a farmer wishes to clear a new area for agriculture is to invite charcoal producers to clear all woody biomass in a given area in return for the rights to produce and market charcoal resulting from the clearance process.

About half of the total charcoal produced in Tanzania supplies the Dar es Salaam energy market, estimated at around 1,500 tons each day. Given the projected rapid expansion of Dar es Salaam's urban population over the next two decades, it is estimated that this figure could rise to around 3,300 tons per day by 2030. Assuming that the current unsustainable charcoal harvesting and production methods continue unchecked, deforestation rates can only be expected to increase proportionately. As a result, natural woodland cover within the districts surrounding Dar es Salaam can be expected to almost disappear over the next decade.

[4] This is based on a 10:1 ratio between wood and charcoal and 80 tons of wood per hectare. This is a conservative estimate. Some woodlands may hold as little as 40 tons of wood. Average wood production from miombo woodlands is estimated at 35 tons per hectare.

[5] Tanzania has an estimated forest cover of 33 million hectares.

FIGURE 2.7 SIMULATED RESULTS FOR CHARCOAL CONSUMPTION AND DEFORESTATION IN 3 DISTRICTS ADJACENT TO DAR ES SALAAM[2]



Source: Authors' Simulations

FUEL EFFICIENCY AND ALTERNATIVE ENERGY SOURCES

Fuel-efficient stoves have been promoted in Tanzania for more than 15 years, and promoters claim that 40 percent of households that rely on charcoal use these improved stoves in urban centers. A survey conducted in 2007 is less optimistic, indicating market penetration rates closer to 20 percent (Palmula and Beaudin, 2007). Almost none of the institutional charcoal users, such as schools and hospitals, are reported to use fuel-efficient stoves[6]. Other initiatives encouraged consumers to switch from charcoal to alternatives such as kerosene and LPG. The main characteristics of the most common alternative fuels currently promoted in Tanzania are summarized in box 2.3. Table 2.1 presents data on reasons for using different fuel sources.

Economic and financial analyses of energy use and fuel switching also frequently mention that charcoal is not as cost-efficient as LPG and other alternative fuels. These analyses, however, are oversimplistic in that they rarely look beyond simple economic factors. It is known that there are a wide range of other factors that affect people's choices when selecting fuel types,—beyond simply price and efficiency (see table 2.1).

[2] The model results should be considered as indicative only. The model takes into account only forest area that is available and usable for charcoal production. The model indicates that under a "Business-as-Usual" scenario, the forests will be significantly degraded and disappear in the three districts adjacent to Dar es Salaam where most of the charcoal for the city is currently produced. Under this scenario, it can be assumed that the supply source will shift to districts farther away, thus, complete deforestation is not likely to occur, but usable and accessible natural forest area (Miombo woodland) will disappear. For degraded Miombo woodland near urban centers wood stocks ranging between 0.3m3/ha near roadsides to 15m3/ha on public lands are reported. In comparison, stocks of undisturbed Miombo woodland are ranging between 35m3/ha and 47m3/ha (CHAPOSA 2002, Luoga et al. 2002). Other tree resources that will remain in the area are trees outside forests (e.g. agroforestry) which will, for example, continue to be used for fuelwood collection, but also forests in protected areas or other conservation sites.

[6] Although institutional-size, ceramic-lined stoves are not generally sold on the market, they can be special ordered from stove manufacturers.

BOX 2.1 SUMMARY OF CURRENT INITIATIVES FOR PROMOTING ALTERNATIVE FUELS IN TANZANIA

Interest in **liquid biofuels** is surging in Tanzania. Some biofuels not only have the potential to be used for cooking, but also in generators for producing electricity. Current initiatives focus on developing bioethanol from sugarcane, cassava, or sorghum, and biodiesel from either palm or jatropha oil. There is currently no biofuel production in Tanzania, but a good deal of land clearing and planting is under way, mainly to develop biofuels for transport. Currently there are no government guidelines for biofuel investments in the country.

Kerosene is a flammable hydrocarbon liquid, also sometimes referred to as paraffin, and supplies fuel for both lighting and cooking. Kerosene is used as a domestic energy source by about 25 percent of urban Tanzanians, but not for the most part as their primary energy source. Kerosene smokes and has an unpleasant taste and odor, thus, many people find cooking with kerosene disagreeable.

LPG (liquefied petroleum gas) is butane and propane liquefied under pressure. It is a colorless, flammable gas, found in natural gas, light crude oil, and gases that are formed when heavy oil is refined to produce gasoline. In 2006, the government of Tanzania exempted LPG cylinders and gas from all forms of taxation. Taxes remain on cookers, hoses, and other accessories. In the six months following this change, suppliers claimed a market increase of 50 percent, which has now stabilized.

A compressed **biomass briquette** is a black, brittle substance that can be used as a direct substitute for charcoal. Briquettes can be made from a number of different substances, including waste products. A number of businesses in Tanzania currently produce briquettes, which are used in almost an identical manner to charcoal. Prices are currently less than half that of charcoal, although their calorific value and combustion is often of lower quality.

Ethanol gel is a renewable form of energy made by mixing ethanol with a thickening agent and water. It is easy to use and burns with a carbon-free flame, so it does not cause respiratory problems such as asthma, which can be caused by emissions from paraffin, coal, and wood fuel. Though the product is relatively new, its introduction on the Dar es Salaam market has been rapid and successful.

Second-generation biofuels, such as wood plantations for the production of ethanol, have not yet received ample attention in Tanzania, but could provide a viable option in the future.

Source: ESD 2007

If successful polices are to be designed to address the charcoal challenge and achieve poverty alleviation and economic development, the true economic considerations of charcoal users need to be identified. Low adaptation rates for improved stoves and alternative fuel sources should have been a sufficient indicator that past interventions in this area failed to address consumers' wider needs and constraints.

Box 2.2 provides an example of how poor households make consumption choices in relation to charcoal, given their own financial position and liquidity. It demonstrates that merely comparing costs of alternative energy sources is insufficient to explain the energy choices of poor, urban households in Tanzania. As a result, these analyses will be insufficient for developing innovative; successful polices to promote the adoption of energy-efficient stoves or alternative sources of energy.

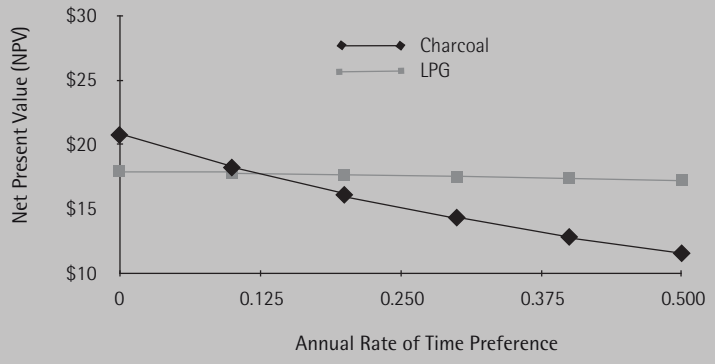
TABLE 2.1 REASONS FOR USING DIFFERENT FUEL SOURCES

	Fuelwood	Charcoal	Kerosene	LPG	Electricity
Inexpensive	89%	71%	23%	53%	2%
Easy to purchase	33%	52%	27%	22%	28%
Easy to use	19%	28%	71%	42%	70%
Traditionally used by household	19%	12%	n/a	n/a	9%
Low initial investment costs	15%	12%	21%	8%	2%
Gives high heat / cooks fast	15%	5%	48%	61%	48%
Safe to use	n/a	20%	2%	8%	26%
Food tastes better	n/a	10%	n/a	n/a	4%
No negative health effects	n/a	6%	n/a	14%	26%
Clean to cook with	n/a	2%	6%	47%	59%

Source: Palmula and Beaudin 2007
Note: Multiple answers were possible

BOX 2.2 COST OF CHARCOAL AND LPG CONSUMPTION: THE CONSUMER VIEWPOINT

Assessments of costs of alternative fuels are generally made "ex-post"—in other words after the consumption has taken place. The costs of consumed amounts are added together for a given time period and compared against one another. However, this ex-post analysis does not take account of the intrinsic valuation of costs of a household, especially as regards its rate of time preference, which is generally expressed as a discount rate. Disregarding initial investment costs, which were estimated at US$83 for LPG and US$3 for a conventional charcoal stove, a household has a consumption choice between a total monthly cost of about US$18 for a refill of LPG (after abolishment of the VAT and import tariffs) or about US$20.80 for purchasing charcoal. The advantage of charcoal is that the household can phase its purchases, such as every two days, while the expenses for LPG have to be made in one payment up front. It can be seen that at rather low positive rates of time preference, charcoal purchases become preferable over LPG purchases. As other studies have demonstrated, rates of time preference for poor households in developing countries are rather high, easily reaching up to 100 percent and more. Based on this simplified calculation, the advantage of charcoal would diminish if LPG could be bought in smaller units, allowing households to phase purchases over time.



Some other factors not considered in calculation:

- Initial investment costs
- Maintenance costs
- Replacement costs
- Risk of unavailability of LPG at time of required refill
- Price fluctuations of LPG
- LPG with VAT and import tariff
- Uncertainty of availability of cash income for poor households

Energy expenses in US$	Days 1	2	3	4	5	...	10	...	20	...	31	Monthly Cost
Charcoal	1.3	0	1.3	0	1.3	...	1.3	...	1.3	...	1.3	20.80
LPG	18	0	0	0	0	...	0	...	0	...	0	18

Sources: Data from Palmula and Beaudin (2007); authors' own calculations

ECONOMIC CONSIDERATIONS OF FUEL SWITCHING

Up until this point, the question of fuel choice has mainly been discussed from the viewpoint of private households. Yet it is also necessary to undertake an economic evaluation of alternative investment options from a government perspective. Such a framework informs decision makers, particularly those in the Ministry of Finance and Economic Affairs, but also in other sectors, where public investments are made in the most efficient and effective ways. Such an economic evaluation should not only look at the direct objective of achieving energy security, but also must take into consideration broader development objectives of the country, such as employment, economic development (especially of rural areas), improving public finances and national budgets, and sustainable management of natural resources.

TABLE 2.2 ECONOMIC COSTS AND BENEFITS OF ALTERATIVE FUEL CHOICES

		Sustainable Charcoal	LPG	Electricity
Employment	Costs		Loss of total number of people employed, especially in rural areas.	Loss of total number of people employed, especially in rural areas.
	Benefits	Large number of poor people employed, especially in rural areas. Labor intensive. Without larger material investments will maintain and create livelihood opportunities for a large labor force.	Limited scope for employment. Mainly skilled and semiskilled and in urban areas.	Limited scope for employment. Mainly skilled and semiskilled and in urban areas.
Revenues	Costs	Enforcement of regulations.	Reduced revenue collection, especially for the forestry sector and at decentralized levels.	Reduced revenue collection, especially for the forestry sector and at decentralized levels.
	Benefits	Significantly improved revenue, especially at decentralized levels.		
Subsidies	Costs	Possibly subsidies to support plantation and woodlot establishment. Can be refinanced through carbon finance.	Subsidies for the investment costs and recurrent costs (e.g. no VAT, support of distribution sites, etc.).	Subsidies for the investment costs and recurrent costs (tariffs below cost recovery level).
	Benefits			
Environment	Costs		Forests lose economic value. Lowers opportunities for alternative land uses and creates incentives for further deforestation in the long term. Increase in fossil-fuel emissions.	Forests lose economic value. Lowers opportunities for alternative land uses and creates incentives for further deforestation in the long term. Increase in fossil-fuel emissions.
	Benefits	REDD-positive outcomes in the medium to long term. Possible revenues from carbon payment schemes (incl. afforestation/ reforestation). Positive spillover effects regarding soil conservation, watershed management, irrigation agriculture, biodiversity conservation, etc.	Reduced forest degradation for charcoal production.	Reduced forest degradation for charcoal production.
Others	Costs		Mainly imported technology.	Mainly imported technology.
	Benefits	Mainly domestically produced technology, e.g. stoves, kilns, etc. Increase in woodlot and plantation areas and extends PFM supported land-use planning and local governance.		

Source: Authors' compilation

Table 2.2 summarizes the main considerations of such an economic assessment. Given the time and resource constraints of this policy note, the evaluation is limited to a qualitative discussion of costs and benefits. Based on this discussion, a qualitative valuation of these aspects could be carried out at a later time.

Again, this economic analysis has to be critically looked at with the knowledge that different fuels will be used by different groups in society or for different purposes. There is no single energy source that can meet all requirements given the different uses and applications. Knowing that a large number of households will not be able to switch to alternative fuels such as LPG or electricity due to the very high initial investment costs, it must be accepted that charcoal will always be in demand, and thus play a role in the country's energy mix.

POLICY, LEGAL, AND GOVERNANCE ASPECTS OF THE CHARCOAL SECTOR

There is no comprehensive policy, strategy, or legal framework in Tanzania addressing the charcoal sector. Four ministries share responsibility, including the Division of Environment (DoE) within the Vice President's Office (VPO), the Ministry of Energy and Minerals (MEM), the Ministry of Natural Resources and Tourism (MNRT), and the Prime Minister's Office-Regional Administration and Local Government (PMO-RALG). Over the years, each of these ministries has issued a range of legal and policy documents that have either direct or indirect impacts upon the charcoal sector. (box 2.5 and 2.6).

With regard to charcoal production, at present the Forestry and Beekeeping Division (FBD) of the MNRT is the primary policy lead at the national level. Due to recent legal changes, district government offices and village governments increasingly play a central role in forestry policy and practice.

As wood is converted to and then used for energy, policy responsibility becomes more complicated. FBD remains responsible for managing charcoal transportation and trade, while MEM becomes involved as the primary policy lead on energy use. The Division of Environment (DoE) has authority to oversee and coordinate the aforementioned line ministries to ensure protection of the environment, including requirements for environmental impact assessments.

BOX 2.3 SELECTED KEY LEGAL AND POLICY DOCUMENTS RELATING TO THE CHARCOAL SECTOR IN TANZANIA

- Guidelines for Sustainable Harvesting and Trade in Forest Produce, MNRT-FBD, 2007
- New Royalty Rates for Forest Products, MNRT-FBD, November 2007
- Community-Based Forest Management Guidelines, MNRT-FBD, April 2007
- Joint Forest Management Guidelines, MNRT-FBD, April 2007
- Charcoal Regulations, MNRT-FBD. 2006
- Environmental Management Act, VPO, 2004
- Forest Act, MNRT, 2002
- Subsidiary Legislation to the Forest Act, MNRT, 2002
- National Forest Programme, MNRT, 2001
- National Forest Policy, MNRT, March 1998
- National Land Policy, Ministry of Lands and Human Settlements Development, 1997
- National Environmental Policy, VPO, 1997

PMO-RALG, through its regional and district offices, is tasked with implementing policy on the ground. As mentioned above, village governments play an increasingly important role in both the management and production of charcoal. In regard to charcoal, village governments possess important independent powers, and should not be seen merely as a level of government subsidiary to regional or district governments.

Charcoal Production

The National Forest Policy (1998) and the Forest Act (2002) provide the legal frameworks for rural communities engaged in forest management through participatory forest management (PFM). The law recognizes two different types of PFM, which:

- enable local communities to declare—and ultimately gazette—village, group, or private forest reserves (commonly referred to as "community-based forest management," or CBFM);
- allow communities to sign joint forest management agreements with governments and other forest owners (commonly referred to as "joint forest management" or JFM).

Data from the FBD indicate that by 2008, 4.1 million hectares of forest land was either under local management, or in the process of being transferred. Of that area, 2.3 million hectares were under CBFM, and over 330 village forest reserves have been declared (MNRT 2008)

BOX 2.4 KEY FOREST POLICY AND FOREST ACT STATEMENTS REGARDING COMMUNITY INVOLVEMENT IN FOREST MANAGEMENT

Key Statements from the National Forest Policy

Policy Statement 5: To enable sustainable management of forests on public lands, clear ownership for all forests and trees on those lands will be defined. The allocation of forests and their management responsibility to villages, private individuals, or to the government will be promoted. Central, local and village governments may demarcate and establish new forest reserves.

Key Objectives of the Forest Act

- To encourage and facilitate the active citizen involvement in the sustainable planning, management, use, and conservation of forest resources through the development of individual and community rights;
- To delegate responsibility for the management of forest resources to the lowest possible level of local management consistent with national policies.

Licensing of Charcoal Production and Trade

The Forest Act (2002), Charcoal Regulations (2006), and Guidelines for Sustainable Harvesting and Trade in Forest Produce (2007) provide the legal basis for the production and trade of charcoal.

The Charcoal Regulations and the Guidelines for Sustainable Harvesting require the establishment of a harvesting committee at the district level. This committee includes participation by village representatives for areas where charcoal production is occurring (§ 4(c)). The responsibilities of the harvesting committee include:

- developing district harvesting plans (§ 4(c)). No guidance is given in the regulations as to how a district should develop such a plan or what lands it should cover.
- receiving and granting approval for applications for permits to harvest forest products (including charcoal) (§ 4).
- defining standards for granting permits to produce charcoal under section 7. It is unclear whether permits for "harvesting" forest products, which the committee has authority to require, and a permit to "produce" charcoal are the same.
- considering and issuing licenses for charcoal "dealers" (§ 5).
- requiring district and village governments to create registries of charcoal dealers.
- helping "local area authorities" develop special areas for charcoal production (§ 4). It is unclear whether these "local area authorities" include village governments.

The scope of the Charcoal Regulations and associated powers of the district harvesting committees are unclear, and in many cases have been interpreted to cover all village forest lands, extending control over the harvesting of trees for the production of charcoal in these areas to district committees rather than village governments. The issuance by the FBD of the Guidelines for Sustainable Harvesting have clarified this area of uncertainty by clearly stating that forest land under recognized communal management (such as a village forest) or private management (woodlots or trees on farmland) are not covered under these regulations. Despite this recent clarification, much uncertainty still prevails at the district level regarding the power and influence of the district harvesting committee.

Charcoal traders are required to register with local government authorities and pay an associated license fee. In addition, the legal transport of charcoal requires payment of a local levy, or "cess," which is payable to local governments. The collection of these fees is chronically low in most areas. This is due to a number of reasons.

- While local governments have the primary responsibility for licensing and regulating the charcoal trade, very little of the total revenue can be legally retained at the district level. Apart from the charcoal transport levy (cess), all other

charcoal revenues and fees are remitted to back to the Ministry of Finance and Economic Affairs. This includes fines levied on those who are found to be breaking the law. This is a key factor in accounting for the chronic undercollection of charcoal revenues across the country. Clearly, there is little incentive for local governments to invest staff time and resources into revenue collection when the majority of funds are submitted directly to the central government.

- Local government efforts to collect revenue from charcoal production and transport may be constrained by the involvement of key local government staff and leaders in the charcoal trade itself, and their unwillingness to impose increased costs on personal business interests.

- Finally, capacity constraints also undermine local government efforts to collect charcoal revenues or enforce the law. Funds generated from charcoal revenues are rarely reinvested into revenue collection or sustainable natural resource management. These funds tend to be targeted toward priority sectors such as health, education, and transport, leaving natural resource staff chronically underresourced.

These factors in combination result in massive undercollection of local government revenues. In a study conducted in the Iringa District in 2001, it was estimated that in terms of royalty and district cess value, the production of charcoal in the Iringa District was estimated at potentially generating USD$440,000 per annum. Actual tax collection in 2001, including license fees, was equivalent to US$3,500 or 0.8% of the total (Koppers 2002).

As indicated earlier in this chapter, it is estimated that around 80 percent of the charcoal trade takes place outside the formal system. Instead of obtaining the necessary licenses or paying required fees, the majority of producers and traders chose to evade payment, and, where necessary, pay bribes when challenged by either the police or government checkpoints. The reasons for evasion are many, but some common causes are listed below.

- High costs incurred in travelling to the district forestry office and waiting for the license to be issued.
- Those involved in the trade are unable to pay license fees (and the accompanying bribe needed to facilitate licensing).
- They also are attracted by the willingness of law enforcement staff to accept bribes at a fraction of what it would cost to obtain a license.

As a consequence of the illegal and informal nature of the charcoal business, it is estimated that the government fails to collect taxes of about US$100 million annually. Similar findings have been obtained for neighboring countries such as Kenya[7], Uganda, Malawi[8], and Rwanda.

A second study undertaken in Iringa District was able to demonstrate massive improvements in revenue collection efficiency when responsibilities for revenue collection were devolved to 14 villages implementing CBFM. The revenue collected by those 14 villages far exceeded the forest revenues collected by the district council from the remaining 153 villages without established CBFM. Consequently, the decentralization of taxation to these villages appears to have massively improved efficiency and effectiveness, and has resulted in considerable improvements in village-level public finance.

Effectiveness of Policy Measures to Date

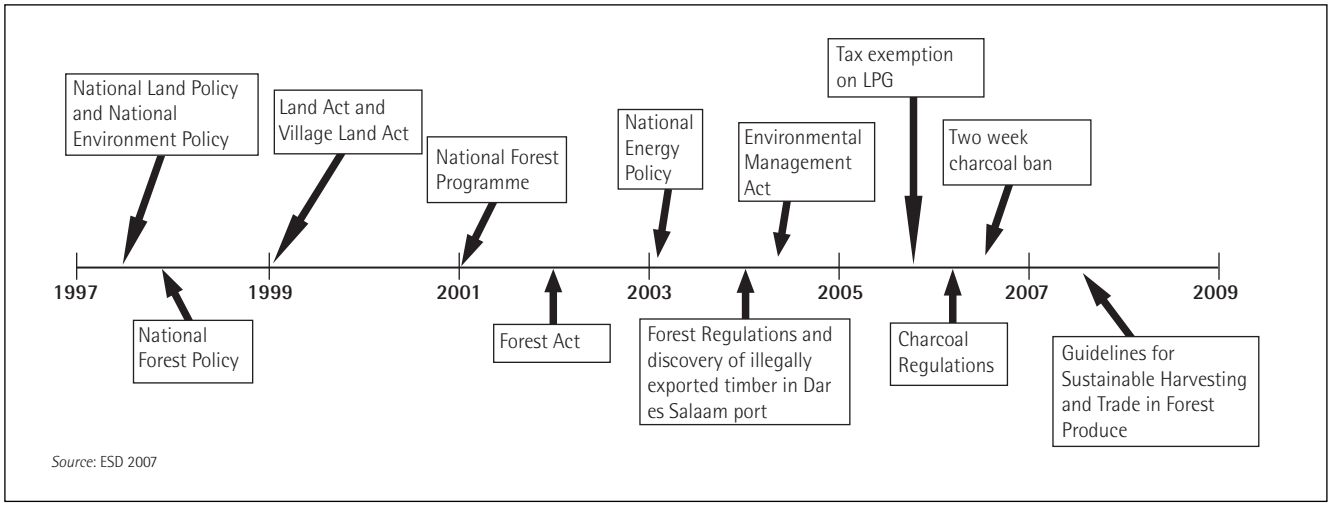
The government has implemented a range of policy measures over the past decade designed to address the production, trade, and consumption of charcoal, as well as other energy sources. These are summarized in boxes 2.3 and 2.4, and in figure 2.8, below. They can be broadly categorized into two main types. Between 1997 and 2004, the main focus of policy makers was to set the foundations for policy, which included key reforms in the forest sector designed to increase participation and involvement of forest users in the management of forests.

However, from 2004 onward, and following the exposure in the press of large volumes of illegal timber exports in the Dar es Salaam harbor, efforts by the government were directed toward exercising greater control and influence over trade in forest products, including charcoal and timber. This came as wider environmental concerns such as deforestation, and destruction of catchment forests, were increasingly being raised in the press—including the impact of this on water and power supplies across the country, experienced between 2005 and 2007. One of the most radical measures designed to reduce deforestation in water catchments and coastal forests was the ban, by the Minister of Natural Resources and Tourism of trade and production of charcoal in 2006. The outcry from urban charcoal users was predictably loud, and as a result, the measure was short-lived—

[7] For Kenya, revenue losses from clandestine charcoal production and trade are estimated at K Sh 5.1 billion or US$65 million (ESD 2007).

[8] For Malawi, Kambewa et al. (2007) estimate the size of the at about MK5.78 billion a year, with a potential to collect about MK1.0 billion annually in revenues.

FIGURE 2.8 TIMING OF KEY POLICY MEASURES RELEVANT TO THE CHARCOAL SECTOR



Source: ESD 2007

being reversed after only two weeks. An important impact of the charcoal ban was the loss of all government revenue collected from charcoal, as all production and trade was illegal. However, due to the massive demand for charcoal, the trade continued, albeit illegally, and corruption at checkpoints increased. The greater transaction costs associated with the (illegal) production and trade in charcoal were simply passed on to the consumer, and immediately following the ban, the price of charcoal nearly doubled. Prices have generally remained at these higher levels, despite the resumption of legalized charcoal trade.

Measures that provide incentives for changed behavior are more likely to achieve the desired result than measures designed to impose greater costs and sanctions. A good example of the more positive forms of policy making can be seen in the Forest Act, which provides a range of policy incentives for communities to declare and sustainably manage village forest reserves (such as waiving state royalties, and devolving all management decisions and benefits to village governments). These legal changes have resulted in a massive surge of interest in community-based forest management over the past decade.

CHAPTER 3 LESSONS LEARNED FROM TANZANIA AND OTHER COUNTRIES

This section provides an overview of how various countries, including Tanzania, have sought to address the charcoal sector along the production-trade-consumption chain. Initiatives are presented that include both practical measures implemented on the ground, as well as changes made at the policy and regulatory levels across the whole sector. The section concludes with a summary of the various policy options and their respective advantages and disadvantages.

CHARCOAL PRODUCTION

Management of Natural Forests and Woodlands

Across Africa, the past two decades have witnessed a growing movement to empower rural communities with rights and responsibilities with which to manage forest resources. Participatory or community forestry has taken root across many countries on the continent and uses a range of different models, including the full transfer of management rights and responsibilities (community-based forest management) and more collaborative arrangements, where forest management responsibilities are shared between government and communities (joint forest management). Despite the variety of approaches, one of the key lessons that has been learned across different countries is that security of tenure is a key factor that determines whether PFM succeeds or fails—both from a forest management perspective, and from the perspective of securing and maintaining participation over the long term. One example of where this appears to be working well is in Ethiopia (see box 3.1).

BOX 3.1 THE WAJIB APPROACH TO COMMUNITY-BASED FOREST MANAGEMENT IN ETHIOPIA

In **Ethiopia**, the approach to natural resources management differs from many other participatory forest management (PFM) approaches in Africa because the number of participating households is limited to the forests' carrying capacity and economic potential. The approach, called "WAJIB" requires a binding agreement between the local forest user groups and the district forest office, with clearly stated rights, duties, and obligations for both partners. The underlying assumption is that households will only invest in forestry operations if they can make a living from sustainable forest management. Thus, the forest in a given village is subdivided into forest blocks, with an average minimum size of 360 hectares. Based on the forest carrying capacity of, for example, 12 hectares per household, each block is managed by a WAJIB group of not more than 30 households. Each WAJIB group has its own bylaws, which govern the use, protection, and rights and responsibilities of each household within the block. In the context of this example, the main duty of the forest administration is to provide technical advice to the WAJIB groups on how to develop and utilize the forest on a sustainable basis. One risk identified for this approach is that well-off households benefit disproportionately from additional income, and the poor and landless (who formerly profited from uncontrolled charcoal making) are excluded.

Source: Sepp 2008a

A further example is provided from Senegal, where clear and binding agreements have been reached regarding how revenues from charcoal production and trade in community forests are shared between user groups and a local development fund (box 3.2).

BOX 3.2 COMMUNITY-BASED FOREST MANAGEMENT FOR WOOD FUEL PRODUCTION IN SENEGAL

In Senegal, the forest law creates opportunities for rural communes to formally claim possession of hitherto state-controlled forests adjacent to their community, and to manage them in accordance with a publicly approved forest management plan. Additionally, state forests may be allocated to communes for co-management.

Communes, in turn, enter into contracts for the purpose of granting use rights on the village level. Detailed, inventory-based management plans are prepared, which also reflect and harmonize locally perceived needs and expectations. Each village establishes a management committee, and households interested in utilization of certain forest products form respective user groups.

The following benefit-sharing formula has been consensually adopted among stakeholders: 55% for the producer groups, 25% for a communal forest management fund, and 20% for the communal development fund.

Source: Sepp 2008a

Most charcoal-related management challenges occur in arid or semiarid regions of Sub-Saharan Africa with low and erratic precipitation. Such regions are typically characterized by savannah-type vegetation. Savannah woodlands of this type are not suited to producing high value timber, although their contribution in terms of non-timber forest products, such as fodder, gums, and resins, may be substantial.

In Tanzania, when communities are granted full tenure and management rights over forests in their village area (village land forest reserves), evidence suggests that forests are managed both sustainably and to the benefit of local development and people. Under joint forest management regimes, the failure of government and communities to reach binding and enforceable agreements on how the costs and benefits of forest management are shared has meant that progress has been limited and the long-term sustainability of this approach is now being questioned.

In Iringa District communities have sustainably managed woodland areas for charcoal production for a number of years, following a successful project funded by the Government of Denmark that supported community-based forest management. Recent studies suggest that communities that produce and market wood from community forests for charcoal production face unfair competition from illegally harvested charcoal. Wood that is illegally or unsustainably harvested to produce charcoal is generally free, and the producer only incurs labor costs, which means the product can be sold at a price that undercuts charcoal produced from sustainable sources. This example further underlines the need to address the charcoal sector in a holistic manner and look beyond a single intervention along the production–trade–consumption chain.

Plantations and Woodlots

Although natural forest management through PFM will continue to play an important role in meeting future demand for charcoal, natural forests will not be able to meet growing demands in a sustainable manner. Therefore, PFM approaches in natural forests need to be reinforced through developing complementary tree plantations. Building on the PFM approach that is well-embedded in Tanzanian forest policy, the promotion of new plantation-type forest areas as smallholder woodlots or plantations on village lands outside of existing natural forests under community-based forest management is a key policy option for promoting sustainable charcoal utilization (see box 3.3).

Planted forests, if managed responsibly, have a particularly important role to play in providing a renewable and environmentally friendly energy resource. In addition, plantations can play a very positive role in: (a) provision of ecosystem services (e.g. erosion control, carbon storage, etc.); (b) reduction of pressure on natural forests; (c) restoration of marginal or degraded land; and (d) provision of rural employment and development.

Two main principles must be followed to fully capture the potential of plantations for sustainable charcoal production:

- No natural forest area should be converted into plantations. Even for degraded natural forests, it is preferable to improve production potential through enrichment planting, rather than full conversion to plantations or woodlots.
- Plantations have to provide direct pecuniary benefits to rural households in order to divert pressures from natural forests. One of the main reasons for rural households to engage in unsustainable charcoal production is their need for cash, which is almost exclusively provided by the charcoal business.

BOX 3.3 HOUSEHOLD TREE PLANTATIONS FOR CHARCOAL PRODUCTION IN MADAGASCAR

A village-based approach in Madagascar, facilitated through bilateral technical assistance and implemented by local NGOs, places local people at the center of planning and implementation of plantation management for sustainable charcoal production. It is based on voluntary participation of communities eager to rehabilitate degraded lands by means of voluntary reforestation. As a first step, an afforestation area is identified by the community and legally registered as a "Réserves Foncières pour le Reboisement" RFR. A village-based participatory approval process allocates individual woodlots to interested households, along with defined use rights and obligations. Each plot is demarcated, mapped, and documented with the community's approval. Technical assistance is provided by specially trained NGOs in a three-stage approach, with a total implementation period of 21 months.

Aside from institutional and technical support, the only substantial external input is mechanized soil preparation. Tractors must be used to break up compact layers in degraded soil, to increase percolation of rainwater and ensure higher survival rates of seedlings. Nursery operation, planting, and maintenance are the plantation owners' responsibilities. An overall geographic information system (GIS) based monitoring system provides data for every plantation plot, including productivity figures, income generated, etc.. The establishment costs are estimated at US$ 300 per hectare, of which US$ 195 is needed for mechanized soil preparation, and is borne by external funding and US$ 105 by the households in form of labor input. So far, more than 4,500 hectares have been planted, providing an annual increase in income of more than 20% for more than 1.500 rural households. The monitoring system further revealed that 34% of the poorest and landless people became involved, and 22% of women enrolled as woodlot holders. In addition, the uncontrolled exploitation of natural forests in the vicinity of the villages substantially decreased, as did the incidence of fires.

Source: Sepp 2008a and GTZ-ECO 2006

Preferably, plantations should be established on degraded lands. Furthermore, rural people should not be forced to engage in plantation establishment. Promotion of plantations at the community level can only be successful if based on voluntary participation of communities eager to put unused land under production by means of voluntary reforestation.

It would be expected that in the medium to long term, fiscal reforms targeted at the charcoal sector would mobilize sufficient resources to make plantation establishment self-sufficient as regards external financial inputs. There are best-practice examples of innovative financial incentives that provide incremental financing for afforestation and reforestation in cases where private incentives are insufficient to prompt rural households to engage in tree planting. Similar financing mechanisms should be tapped as much as possible to increase the economic viability of plantations and increase direct income streams generated through plantations. The higher the benefit streams from plantations, the more likely it is that households will decide to engage in plantation establishment as an economic activity, rather than in other uses of the land. An example of how direct payments are used to encourage tree planting at the household level using a deposit account system is summarized in box 3.4. Increasingly, innovative financing mechanisms are linked to carbon payments either through the voluntary market or the Clean Development Mechanism established under the Kyoto Protocol. Recent experiences with a pilot project in Tanzania are summarized in box 3.5.

As an investment, woodlots and small tree plantations have a number of additional advantages that increase their overall attractiveness to rural households on limited incomes. First, once trees are at a harvestable age, the potential period for selling the trees and converting them into cash extends over several years or even decades. This allows farmers to use woodlots rather like savings accounts. Farmers can time their harvests to coincide with periods when major one-off payments are required (for example for funerals, school fees, or purchases of agricultural inputs). Second, trees are an inflation-free investment that is likely to grow in value as prices for charcoal increase.

BOX 3.4 BENEFIT SHARING THROUGH A DEPOSIT-ACCOUNT SYSTEM IN VIETNAM

Subsistence farmers usually do not have access to capital. Poverty often contributes to environmental degradation, resulting in a progressive depletion of natural resources. Therefore, it requires innovative mechanisms to invest capital in the rehabilitation of natural resources, in particular in the establishment and management of forests. These funds should be directly channeled to the participating smallholders.

An innovative approach to promoting afforestation among rural households, and builds on the active participation of smallholders in the entire environmental rehabilitation process was developed for Vietnam. Funds for investments are directly transferred to deposit accounts of participating beneficiaries at a local bank. Three preconditions must be fulfilled for smallholders to participate in these investments:

- proof of land tenure security for a piece of forest land;
- all land of the village subject to participatory land-use planning; and
- participating farmers follow the guidelines governing the respective investments.

Only when these prerequisites are met can the smallholder can open an account at a rural bank. In addition, the farmer receives special training, seedlings, and fertilizer free of charge. Depending on the size of the forest land and the volume of his/her investment, a fixed amount of money is credited to the farmer's account. This is to compensate smallholders for their labor input and to serve as an incentive to gain their long-term participation. After planting and final approval of the responsible authorities, the farmer can withdraw 15% of the paid-in capital from his account. The following year he can withdraw another 15%, provided the plantation is managed according to the technical guidelines. Moreover, the account accumulates interests, which can also be withdrawn. For eight years, farmers are able to withdraw from their deposit accounts, provided they manage and protect their forest land according to the guidelines. After nine years the first products can be harvested from the forests, mainly for fuelwood, poles, and nonwood forest products.

Source: GFA Consulting Group

BOX 3.5 CARBON-BASED PAYMENTS AS INCENTIVES FOR TREE PLANTING AT THE HOUSEHOLD LEVEL—EXPERIENCES FROM TANZANIA

Development benefits of carbon-based payments for afforestation and reforestation activities can occur at several different levels, e.g., including both participants and nonparticipants, as well as for the host country as a whole. A particularly thoughtful design of the institutional structures is essential to foster improved rural livelihoods and natural resource management.

For example, a pilot program in Tanzania aimed to channel carbon finance payments to participating local villagers through a voucher-based system by using a network of rural banks throughout the country. However, bank accounts in which to deposit the program's vouchers could often only be opened in larger rural villages, while farmers exhibited high immobility due to prohibitive opportunity costs of transport in remote rural areas. As a result, the vast majority of farmers participating in the pilot program ran into difficulties because they were unable to travel to the next branch of the rural bank on time, leading to criticism that the vouchers would expire and could no longer be deposited.

Nine of 10 farmers were found to visit the next larger village with a rural bank branch only once per year, most often during the Christmas Holidays to visit relatives. However, none of the banks operating in the research area was open during Christmas. Therefore, farmers were often unable to receive the payment they were rightfully expecting for their activities. This resulted in an increasing lack of trust in the program design and its institutions.

This demonstrates that the benefit-sharing mechanisms must be very carefully designed to address the specific constraints of farm households in remote rural areas. Exploratory household surveys and rapid appraisals may be used to learn of location-specific constraints in order to set up an adequate payment system. For example, non expiring vouchers would allow for more time and flexibility for the household members to deposit the vouchers at the nearest local bank.

Source: Scholz 2009

Development of plantations and woodlots at the community level can also be promoted through outgrower schemes (see box 3.6). Although outgrower schemes are rare in the context of charcoal production in Sub-Saharan Africa that supplies to domestic markets, it is theoretically possible that a private entity invests in modern, industry type carbonization technology (see table 3.1), but sources its raw material through contractual relationships with smallholders. Such a setup would provide adequate benefit-sharing incentives to rural households that are necessary to motivate households to engage in tree planting instead of alternative land uses.

BOX 3.6 OUTGROWER SCHEMES

Through outgrower schemes, companies (or other entities) with inadequate forest holdings or access to public forests seek to secure additional supplies to meet their demand for raw material. Forestry outgrower arrangements between growers (or cooperatives) and processors may be characterized as:

- partnerships in which growers are largely responsible for production, with company assurance or guarantee that they will purchase the product;
- partnerships in which the company is largely responsible for production, paying landholders market prices for their wood allocation;
- land lease agreements in which landholders have little involvement in plantation management; and
- land lease agreements with additional benefits for landholders.

Under outgrower partnerships, growers allocate land and other resources to the production and management of trees, and sometimes other forest products, for a processing company, with the company providing a guaranteed market. The varying responsibilities of each partner are defined by contract.

The incentives for forest processors to develop outgrower schemes include increased supply of wood resources, access to productive land, resource security without the need to purchase land, diversification of supply, and increased cooperation with local communities. For growers, the advantages include an alternate and additional source of income, a guaranteed market for products, reduced market risks and, in some cases, financial support for enterprise development.

Existing outgrower arrangements vary considerably as to whether they are mutually beneficial, achieve sustainable forest management, and meet the social, technical, or economic goals of the partners. Not all outgrower partnerships are viewed as successful, and poor grower-industry links are regularly identified as one of the major constraints to forestry development throughout the world.

Source: FAO 2001, World Bank 2007

Trees outside Forests

In the African context, the contribution of trees outside forests (TOFs) to the energy supply still remains largely underestimated. Statistics on wood fuel supply do not adequately capture this resource, even though a major part of the rural household supply is covered by TOFs. Existing policies concerning rural development still neglect TOFs as one of the most important wood fuel supply resources besides natural forests and plantations. Some countries consider TOFs a responsibility of ministries in charge of agriculture, while others attribute it a responsibility of the forestry or environment institutions.

Trees outside forests include all trees found on non-forest and non-wooded lands, i.e. trees on agricultural lands, in urban and settlement areas, along roads, in home gardens, in hedgerows, scattered in the landscape, and on pasture and rangelands. Most of the knowledge on TOFs derives from the experiences in agroforestry[9].

Although TOFs fulfill a multipurpose function and are part of an integrated land-use system, wood fuel can be a main product. According to the Food and Agriculture Organization of the United Nations (FAO), over two-thirds of the energy demand in the Asia-Pacific region is supplied by wood fuels from non-forest sources.

[9] Agroforestry is the practice of growing trees and agricultural products in the same area at the same time. Agroforestry helps farmers create more integrated, diverse, productive, profitable, healthy, and sustainable land-use systems.

TOFs for charcoal can occur in various places and ways: in home gardens or as replacement or enhancement of natural fallow vegetation. To control soil and water erosion, trees and shrubs can be planted along the contour lines on slopes or on terraces. Living fences planted as tree lines on farm boundaries or on pasture plots, animal enclosures, or around agricultural fields, can also contribute to the energy supply of local households.

The species most often used for wood fuel should preferably be fast growing hardwoods, which can be harvested as coppice after four to six years. The trees should adapt well to site conditions and have nitrogen-fixing properties. As for plantations, management procedures must match the capacities of rural populations. It is imperative to use species resilient to grazing by livestock or wildlife to minimize costs for forest protection[10].

The socioeconomic and ecological advantages of agroforestry greatly outweigh any ambitious tree planting program because agroforestry can be developed at a fraction of the cost of plantations (and stimulates greater local participation and a wider diversity of goods and services for the local and national economies). The major constraint to wider dissemination of agroforestry approaches often arises from complex land tenure systems in Africa.

Charcoal Production and Briquetting

The conversion of wood to charcoal plays a small but crucial role in the charcoal value chain. In most instances, charcoal production takes place using traditional earth or pit kilns, where wood is cut and stacked before being covered in earth and carbonized. This is a highly inefficient process, with a conversion efficiency of around 8 percent to 12 percent (table 3.1). Despite the low efficiency rates, these kilns represent practical, low-investment options for poor producers, particularly when conversion is taking place illegally, and risks of arrest or confiscation of the product is high.

Many projects have tried to overcome the challenge of low efficiency levels by promoting more efficient kilns for charcoal production, but adoption rates have been disappointing. The reasons for this are mainly found in the informal—and often illegal—nature of charcoal production, as frequently described throughout this paper. Without secure and long-term access to wood resources, investments by producers for more efficient conversion methods are likely to be limited. Additional challenges that have been encountered when promoting improved conversion technology include:

- the cost of improved kilns, which may be prohibitive for small-scale producers with limited purchasing power and very little access to credit;
- given that most charcoal is produced in the drylands where forest cover is low, charcoal production tends to be highly mobile. Improved kilns tend to be stationary, which places additional costs on producers due to the need to carry wood from the point of harvest to the kiln. This can be an arduous and time-consuming task over rough ground.

In recognition of these potential challenges, there is an increasing body of experience in Tanzania (and other east African countries) relating to promoting low-cost improvements to the traditional earth kiln design. The Tanzania Traditional Energy Development and Environmental Organization (TaTEDO) has pioneered this approach with a range of simple adaptations to traditional designs that can achieve significant savings at a

TABLE 3.1 EFFICIENCY OF ALTERNATE KILN TECHNOLOGIES

Characteristics	Traditional Kilns	Improved Kilns	Semi-industrial Kilns	Industrial Kilns
Conversion Technology				
Efficiency	**8-12%**	**12-18%**	**18-24%**	**>24%**
Emissions (in g per kg charcoal produced)	**CO_2: 450 - 550 CH_4: ~700 CO: 450 - 650**	→	→	**CO_2: ~400 CH_4: ~50 CO: ~160**

Source: Adapted from Sepp 2008b

[10] The World Agroforestry Centre maintains freely accessible databases providing information on the management, use, and ecology of a wide range of tree species that can be used for fuelwood purposes in agroforestry. (http://www.worldagroforestry.org/sea/Products/AFDbases/AF/index.asp)

low cost. These include the introduction of a chimney, as well as ensuring that wood used in the kiln is adequately dried and cut into approximately similar sizes. Semi-industrial and industrial kilns (table 3.1) have met with some success, but only under intensive production systems (such as in a plantation setting or with significant external investments by a private sector enterprise dedicated exclusively to charcoal production).

CHARCOAL TRADE

As described in the previous chapter, poor governance and ineffective regulation of the charcoal sector means that charcoal is sold at a price well below its true value, as the cost of the resource itself (wood) is rarely factored into the final price. This means that wood for charcoal that is harvested from regulated and sustainably managed areas will necessarily attract a higher price than unregulated charcoal. These price distortions provide significant disincentives for communities or entrepreneurs wishing to invest in sustainable and regulated charcoal trade as long as the risk of price undercutting prevails from the illegal sector. In the long term, if producers are to be encouraged to invest in sustainable charcoal trade, they will need to be sure that they can operate competitively against other producers. This can be achieved in a variety of ways, such as:

- reducing the scale of illegal trade to a level where it does not impact significantly on the formal charcoal trade. This can typically take place through a targeted investment in regulation and control to ensure that the costs of trading in illegally produced charcoal are higher than the costs of trading in charcoal that is licensed and regulated;
- providing subsidies or fiscal incentives for sustainably produced charcoal that compensate for price differences when compared to illegally produced charcoal;
- "eco-labeling" charcoal so that despite higher prices, consumers buy it based on the knowledge that they are contributing to sustainable development and improved producer prices. This process of product differentiation, however, does not address the widespread and dominant trade in unregulated charcoal.

All three of these measures have been attempted, with varying degrees of success. Perhaps the best-known example of fiscal incentives comes from Niger, which introduced a variable tax regime to incentivize sustainable production and penalize unsustainably produced charcoal (box 3.7).

BOX 3.7 EXPERIENCES WITH FISCAL INCENTIVES FOR SUSTAINABLE CHARCOAL PRODUCTION IN NIGER

The first country to attempt to use fiscal incentives as a tool to regulate charcoal production was Niger, where in 1989 the government created "rural markets," or well-marked locations where firewood had been sold by villages from locally managed wood resources. Harvesting regimes were based on long-term sustainable harvesting plans. The two key elements for success were:

- Villages operating a rural market were allowed to levy a tax, which remained largely in the village. This was additional, fixed revenue for the village and belonging to the whole population, rather than just those involved in the wood fuel business; and
- The tax level depended on a number of variables: (a) how far the market is from Niamey, with higher tax levels the closer the market is; (b) whether it is sustainably produced wood near the rural market (lower taxes); (c) if it is from a zone with excess wood where wood harvesting is allowed; or (d) if the wood illegally cut (highest tax level).

In this way, transporters had an incentive to visit rural wood markets rather than open access areas. At the same time, villages had an incentive to obtain approval for operating a rural wood market, for which several conditions existed: (i) delineation of village borders; (ii) drawing a map of wood resources, including dead wood; (iii) developing simple wood fuel harvesting management plans; and (iv) establishment of a management committee. Once all conditions were fully satisfied, villages were allowed to sell wood and levy the tax. Coupons were used as a mechanism to indicate the origin of the wood and the quantity transported. Around Niamey, a control system was set up verifying whether wood transporters had already paid their taxes. If not, they were assumed to have obtained wood from a nonmanaged zone and paid tax accordingly. Even though the tax payment compliance mechanism no longer exists, the rural markets still function, and a tax is still levied, but now directly by the village.

Sources: van der Plas 2008, see also Chomitz and Griffiths 1997

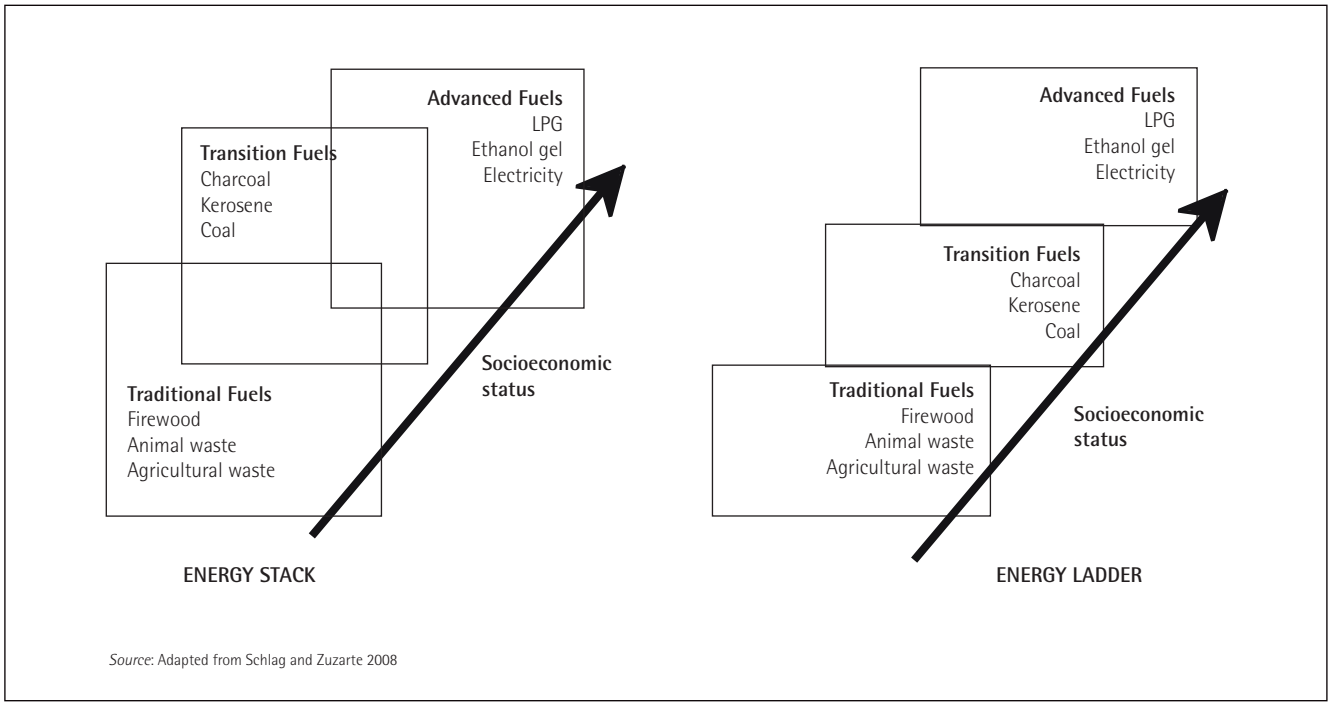
Introducing fiscal measures that encourage illegal charcoal producers to move into the formal sector will have a range of positive and negative spinoff effects. On the positive side, formalization will provide greater security for producers and traders, which will in turn encourage longer-term investments designed to increase efficiency and sustain supply. On the negative side, however, encouraging producers and traders to engage in legal and regulated business will necessarily result in price increases for the end user, as the final market prices reflect the true value of not only processing and transport costs, but raw materials and licensing as well. However, experience would suggest that these price increases will in turn encourage efficiency savings across the whole production-trade-consumption chain.

Given the tight control exercised over the charcoal trade by a limited number of influential businessmen in many countries, efforts to reform the sector are often strongly resisted. Linkages between large-scale charcoal traders and political leaders are often close. If the strong and vested interests operating in the charcoal sector are to be overcome, it will require strong political support—both within government and the political system—but also among the users and consumers of charcoal within urban centers. Otherwise, failure to address the challenges of formalization will ultimately undermine efforts to address the problems of charcoal trade elsewhere along the production-marketing chain.

CHARCOAL CONSUMPTION AND FUEL SWITCHING

Conventional wisdom suggests that economic growth will trigger a reduced demand for wood and other biomass, with consumers, and countries, increasingly moving toward the use of LPG, natural gas, and other fossil fuels. More recent research, however, indicates that this sequential progression from wood fuels to commercial fuels is by no means linear. In many cases, households use various fuels for the wide variety of cooking and heating tasks that are required. The implications of this are that even with economic development, the use of charcoal may not decline proportionately, as fossil fuels may be used as a supplement, rather than a substitute, for wood fuels. In fact, biomass consumption often still increases in growing economies, due to the fact that fossil fuels are simply added to the energy mix, not substituted for wood fuels (see Matthews 2000).

FIGURE 3.1 COMPARISON OF THE ENERGY LADDER AND ENERGY STACK THEORY



Source: Adapted from Schlag and Zuzarte 2008

As discussed in the previous chapter, incentives for users to switch from charcoal to fuels such as LPG are not only driven by issues of price. More often than not, other considerations play an equally important if not greater role in determining fuel use. Poorer households cannot necessarily afford to switch to more expensive fuel sources, particularly if they have to pay the costs all at one time. However, if the costs can be broken down into smaller amounts, it is more affordable for those who have only limited disposable budgets.

A study conducted by USAID on urban energy use in Uganda found that stove efficiency varied according to the type of food being cooked and the type of heating that was required. Heating of traditional foods was in some cases found to be most efficient when using traditional methods (USAID 2007). If the same food preparation tasks were performed using modern cooking stoves, the study found that efficiency levels might decline. Wealthier households tended to use a mix of traditional and modern cooking methods, depending on the tasks. LPG, for example, was used for short heating tasks (like boiling water for tea or warming a meal), while charcoal was used for preparing meals requiring long cooking times, as well as roasting meat that requires high heat.

A large number of initiatives have been developed over the past three decades with the aim of promoting improved cooking technology. One of the most well-known and documented of these was the design and promotion of the Kenya Ceramic Jiko (see table 3.2) first-generation improved stove, designed for urban consumers of charcoal.

TABLE 3.2 COMMONLY USED STOVES FOR FUELWOOD AND CHARCOAL COMBUSTION[3]

Characteristics	Traditional Phase	Transition Phase	Semi-industrial Phase	Industrial Phase
	3-Stone Fire	Improved Stove (First generation)	Improved Stove (Second generation)	High-Efficiency Stove
Combustion Technology				
Efficiency	**8-12%**	**20-25%**	**25-35%**	**>35%**

Source: Sepp 2008b

Finally, the use of modern fuels and efficient stoves may also generate significant health and safety benefits. The inefficient and incomplete combustion of wood fuels release a number of pollutants, such as carbon monoxide, sulfur, and other particulate matter. Commonly observed diseases resulting from indoor air pollution are, for example, chronic respiratory diseases, including pneumonia, tuberculosis, and acute respiratory infection. Women and children are exposed to these pollutants at significant levels and for longer periods of time. Furthermore, the introduction of improved stoves has been shown to reduce the incidence of injuries to children from burns. Traditional open, three-stone fires present a hazard to young children who spend long periods in the kitchen and are frequently burned or injured by falling onto or near the fire.

CONCLUSION

The review of experiences in this section has highlighted a number of key lessons and conclusions. First among these is the necessity of addressing the broader regulatory and tax framework around which the charcoal sector operates. Unless the market cost of charcoal reflects its true value—which includes raw materials, labor, transport, and all taxes and licenses—any efforts to develop sustainably produced charcoal will always be undercut by illegal charcoal, which bypasses many of these key costs. Market prices of illegal and regulated charcoal can be balanced in two ways: either by subsidizing the costs of regulated charcoal, or by imposing a financial penalty on unsustainably produced charcoal. While the former poses the question of financial sustainability,

[3] In Tanzania, charcoal consumers commonly use first-generation improved stoves or less-efficient stoves.

the latter requires complementary enforcement efforts to assess increased costs on illegal producers, with the expected results of greater compliance in the future.

Ultimately, a mix of both approaches will be necessary. Achieving greater compliance of the informal illegal sector will necessarily result in an increase in prices to consumers, but this will in turn stimulate investments by both consumers and producers that are designed to achieve greater efficiency savings. Formalizing and regulating an important sector like charcoal requires strong levels of political support and willingness to challenge powerful and vested interests—often with strong links to the political establishment. It is perhaps for this reason that the overall success of interventions in the charcoal sector have met with mixed success. But those countries that have taken these bold steps appear to have made the greatest progress. While the political costs of addressing the charcoal sector head-on may be high, the potential rewards are great. Transforming the charcoal sector into a sustainable and regulated enterprise will deliver politically valuable benefits, including energy security, economic development in poor rural areas through income diversification, improved revenue collection, sustainable natural resource management, and a mitigation of the effects of climate change. In the context of climate change, benefits from carbon finance could offset require public investments in sustainable charcoal production.

A second and related conclusion involves the importance of reviewing interventions along the entirety of the supply, marketing, and consumption chain. Many of the least successful interventions both in Tanzania and elsewhere have been those that addressed a single issue or constraint, without considering wider structural challenges.

CHAPTER 4 POLICY RECOMMENDATIONS

Based on the analysis of the charcoal sector described in chapter 2, as well as a review of policy measures adopted in other countries, this section outlines critical actions that should be taken if the charcoal sector is to be effectively regulated and its potential benefits harnessed to the full.

The recommendations have been discussed at, and validated through, stakeholder consultations and workshops, which included decision makers from different levels of the government (Ministry of Natural Resources and Tourism, Ministry of Energy and Minerals, Prime Minister's Office-Regional Administration and Local Government, village environmental committees, representatives from public institutions that use charcoal (e.g., schools, hospitals, prisons), charcoal producers, dealers (wholesale and retail), traders, NGOs, producers of alternative fuels (such as LPG and charcoal briquettes), and others.

Policy recommendations are provided along the charcoal value chain, but given critical nature and its potential impact on other parts of the charcoal sector, this section will begin with the regulatory and fiscal frameworks. At the end of each section, a summary table is provided that shows some of the short- and long-term actions required to put these recommendations into practice, as well as some key institutions that would have to be involved in leading the process.

ADDRESSING THE REGULATORY, FISCAL AND PRICING FRAMEWORKS

Districts should be allowed to retain a portion of fees and fines collected from licensing charcoal. If district councils are to be encouraged to regulate the charcoal sector, they must be given the resources and incentives to do so effectively. It is proposed that the central government (the Ministry of Finance and Economic Affairs, together with the Ministry of Natural Resources and Tourism) develop a pilot initiative in a limited number of districts that have expressed a willingness to participate and commitment to implement the measures in full. The pilot would allow district governments to retain charcoal revenues (licenses and fines) levied on areas outside national or village land forest reserves. This would include unreserved village forests, as well as local authority forest reserves. The success of this initiative would be assessed by the degree to which this incentive stimulates local governments to invest increased resources and manpower into the regulation and management of the charcoal sector. If it proves workable, the model could be replicated elsewhere and the appropriate legislative framework be developed to allow for its adoption nationwide.

Districts should be supported to reinvest charcoal revenues in revenue collection and sustainable forest management. Given the limited capacity of district governments to generate their own sources of internal revenue, any local revenue is targeted to priority areas requiring support, such as roads, education, and health, without the usual earmarking from the central government on conditional grants. However, continued and sustained investments by local governments in revenue collection would be necessary if unregulated charcoal production is to be suppressed in the long term. For this to be possible, districts must be encouraged to ensure that a significant portion of revenue collected from charcoal regulation is reinvested to support the sector. Examples of similar models already exist in Tanzania, such as the Road Fund, which is a levy charged on fuel costs, which is reinvested into road construction and maintenance.

Charcoal fees should be transport-based. Because charcoal production takes place across wide areas and involves many tens of thousands of producers, licensing its production has proven to be very problematic. The costs of traveling long distances to

the district headquarters, only to find that the relevant officer is unavailable, means that most producers opt to avoid licensing. It is proposed that instead, licensing of charcoal production and transport be consolidated through the use of transport-based fees. Fees would be based on the number of bags transported. Payments could be done, against issuing of appropriate dated receipt, at any legal payment point. At every checkpoint passed, the receipt would have to be shown, or the respective transit fee paid (and receipt issued). The product would have to be transported to the retail market within one day. If this is not possible, a specific written authorization to extend the validity of the receipt would need to be obtained from the nearest forest office.

The introduction of fiscal incentives can reward sustainably produced charcoal and fine illegal produced charcoal. To subsidize the increased investment costs associated with sustainably produced charcoal, it is proposed that a fiscal incentive scheme be introduced. This scheme would introduce reduced licensing costs for charcoal and could, for example, be implemented by waiving the transport levy (local cess) on charcoal produced from an area with an approved management plan. This could include village land forest reserves, or local authority forest reserves with approved harvesting plans. At the same time, tougher sanctions could be introduced regarding trade in illegally produced charcoal. If effective, over time the relative proportion of charcoal traded officially and formally would grow, and illegally produced charcoal would decline. At the same time, prices to the end consumer of the two forms of charcoal would eventually align, allowing sustainably produced charcoal to profitably compete. Over time, these incentives could be progressively reduced, as they become increasingly effective.

To be successful, it would be necessary to distinguish sustainably produced charcoal in an open and unambiguous way. In addition to different licensing arrangements, it might be necessary to introduce a more visible way to differentiate legal from unregulated products. One option that has been frequently proposed is the introduction of clearly marked bags for charcoal produced in a sustainable manner. While such a system would not only facilitate monitoring of charcoal transport from sustainable production, it would also ease the payment of charges and issuing of permits. In addition, the consumer would have to destroy the seal or bag when accessing the charcoal, so reuse of the bag and the resulting evasion of transport fees would be prevented.

Fixed Trading Sites would help to better monitor charcoal transport and trade. Experiences from a number of countries would suggest that constructing simple charcoal markets in town centers where charcoal can be delivered, sold to transporters, and then carried to more distant urban centers provides an opportunity for greater regulation and formalization of the whole production and trade cycle. Furthermore, it provides economies of scale for producers and traders alike, as well as greater opportunities for the negotiation of fairer prices.

Where possible, these trading sites should be administered by established organizations or associations representing charcoal buyers and sellers. Local government must also have a role in overseeing the operation of these sites, and could opt to use them as centers for levying taxes and fees. For trading sites to be effective, however, it would be important to consult with both traders and producers, with a view to identifying suitable sites where supplies and demand are sufficiently strong. There are a number of examples of market, vendor, or trading sites built by governments, with the very best of intentions, but which are underutilized due to poor planning and location.

Increasing the number and effectiveness of fixed checkpoints will improve law enforcement and governance. While the main thrust of the policy recommendations made in this chapter aim at creating incentives for transforming the charcoal sector, it is important to stress that some form of government regulation or law enforcement will always be needed, particularly during the transition phase, when efforts are being directed to curbing unsustainable and contraband trade.

Increasing the collection of revenue would require significant investments in terms of building both staff capacity as well as infrastructure. The Ministry of Natural Resources and Tourism has a number of established checkpoints along main transport routes, but they are poorly staffed, with low morale, inadequate supervision, and correspondingly high levels of corruption. Police officers are also known to connive with corrupt forest guards (for example by permitting the passage of charcoal trucks through police checkpoints at night, when forest checkpoints are not operating). Clearly, if increased regulation is to be attained, these corrupt practices must be addressed. Supervision of these checkpoints would be essential, and in some cases new staff would be required to break established (and corrupt) networks. Furthermore, strong political support would be important, as it is likely that increased enforcement measures would result in widespread dissatisfaction.

The benefits and opportunities generated by these proposals are many.

- They provide a revenue stream for local governments with which to both address pressing local development needs,

and also support the continued investment in sustainable natural resource management (such as tree planting, community forestry, law enforcement, revenue collection).

- If implemented, they would create incentives for investments and efficiency savings up and down the supply–marketing chain (such as participatory forest management, planting of woodlots, management of trees outside forests, improved kilns, and improved stoves). This would, in turn, result in increased employment opportunities in rural areas because of the projected growth in woodland and forest management, tree planting, and charcoal production.

- They would result in a gradual displacement of unsustainable, opportunistic, inefficient, and unregulated harvesting of trees for charcoal production to areas that are managed sustainably and efficiently.

For these to work, however, would require considerable political will, as producers and traders who previously have operated outside the law would now face additional charges as the trade becomes progressively regularized and formalized. The selection of pilot districts will be critical and will require genuine and unconditional support from local councilors and district leadership. The following table provides a summary of short- and long-term actions that would be required to implement the proposed actions.

TABLE 4.1 SUMMARY OF SHORT- AND LONG-TERM ACTIONS TO IMPLEMENT POLICY RECOMMENDATIONS

Key Intervention Areas	Short- and Long-Term Interventions	Key Institutions
• Allowing districts to retain a portion of licenses and fines collected from licensing charcoal • Supporting districts to retain and reinvest charcoal revenues in revenue collection and sustainable forest management • Fiscal incentives that reward sustainably produced charcoal and place additional fines on illegal products	Short Term • Identification of pilot districts with commitment and political will to reform charcoal trade • Written authorization from MNRT to allow selected districts to retain percentage of charcoal fees and provide fiscal incentives for sustainably produced charcoal (CBFM or planted trees) • Establishment of checkpoints at key points supported by training and supervision of checkpoint staff • Technical support to districts on financial management procedures that encourage reinvestment of natural resource revenues Long Term • Assessment of effectiveness of pilot program on increasing revenue base, improving forest services, and reducing deforestation • Promotion of "success stories" and positive publicity for districts with political will, followed by expansion to other areas	Forestry and Beekeeping Division, PMO-RALG, Ministry of Finance and Economic Affairs Selected "lead" districts within catchment area of major urban center with political will to reform finances
• Moving toward transport-based fees for charcoal • Building fixed trading sites for the transport and trade of charcoal • Increasing the number and effectiveness of fixed checkpoints	Short Term • The gazettement of legal rules on transport-based fees for charcoal by FBD • Public information campaign on new rules and training of law enforcement staff • Identifying suitable sites for trading around Dar es Salaam and supporting construction • Construction of checkpoints around Dar es Salaam and targeted training and supervision for staff Long Term • Expansion of activities piloted around Dar es Salaam to other regions of the country based an evaluation of lessons learned	Forestry and Beekeeping Division, Police, judiciary

CHARCOAL PRODUCTION

Developing harvesting plans for forest areas administered by central or local government would help achieve more sustainable forest management. If Tanzania is to move toward supporting the development of sustainable harvesting of wood for charcoal, it will be crucial that more accurate assessments are provided regarding sustainable harvesting and off-take levels. Currently, harvesting and licensing decisions are rarely driven by accurate assessments of standing stock or resource availability. The Tanzanian Government is in the process of developing a National Forest Resources Monitoring and Assessment, with support from the Government of Finland and the World Bank. It is hoped that this and other, more local assessments, will provide important inputs to the development of sustainable harvesting plans for forest areas administered by central and local governments.

Scaling up Community-Based Forest Management in urban catchment areas will help securing tenure for rural producers. As outlined in chapter 2 of this report, Tanzania has undertaken major policy reforms in the forest sector over the past decade, and has made significant progress in the implementation of a national program of participatory forest management (PFM). The most devolved form of PFM—community-based forest management (CBFM)—offers communities the opportunity to declare and reserve forest reserves on village lands, managed in line with local development priorities.

CBFM provides an opportunity for communities to become involved in establishing and managing sustainable supplies of charcoal, while securing rights over local forest resources and decentralizing control over management planning and decision making. Although significant investments have been made in scaling up PFM by both government and development partners (including the World Bank), at a national level, the total area of forestland covered by PFM arrangements is currently only 13 percent.

If communities are to be supported and become involved in meeting the demands of the charcoal trade from village forests, efforts need to be directed in a more concentrated and targeted manner to remaining unreserved natural forest and woodland patches across the districts neighboring large urban charcoal markets (such as those surrounding Dar es Salaam). Given the rather degraded status of many of these woodland areas (due to unregulated harvesting of wood for charcoal over recent years), it is possible that a period of regeneration and recovery will be needed before sustainable harvesting for charcoal can be introduced.

While it is anticipated that establishing CBFM arrangements will incur heavy initial costs that will require external support, it is expected that fiscal reforms proposed earlier in this section will increase revenue collection at the district and village levels, which will in turn have the potential to cover CBFM support costs without having to rely on external support.

More plantations and woodlots will increase wood supplies for charcoal. Although natural forest management through CBFM will continue to play an important role in meeting future demands for charcoal, natural forests will not be able to meet these demands in a sustainable manner given the projected increase in demand for charcoal and the fact that many natural woodland areas within 200 kilometers of Dar es Salaam will require a period of regeneration and recovery before sustainable harvesting can be established.

Consequently, CBFM in natural forests will need to be reinforced through the establishment of complementary supplies outside forest reserves. One such option is establishing private or group-based woodlots or plantations.

Small- and medium-sized plantations and woodlots, if well managed, have a particularly important role to play in providing a renewable and environmentally friendly energy resource. In addition, plantations can play a very positive role in: (a) provision of ecosystem services (e.g. erosion control, carbon storage, etc.); (b) reduction of pressure on natural forests; (c) restoration of marginal or degraded land; and (d) provision of rural employment and development.

A three-phase approach to plantation establishment under group management is described in table 4.2.

Table 4.2 emphasizes the importance of clarifying and legalizing tenure over the land and planted trees, as well as developing upfront agreements on how rights and responsibilities are shared among participating members. Local NGOs are generally best suited to facilitate the process as outlined above. External support should only be provided in terms of technical advice, dialogue with regional- and national-level governments, and the provision of resources. Experience from Tanzania and elsewhere would suggest that if this model is to work on a scale sufficient to have an impact on overall supply characteristics, some kind of incentive scheme may be necessary. This would assist farmers in obtaining financial support during the early stages of plantation establishment, when costs are highest (labor, seedlings, and tools). An incentive scheme of this sort might be particularly important in overcoming obstacles in participation for poorer members, for whom such a venture might be too costly. Furthermore, by

TABLE 4.2 3-PHASED APPROACH TO GROUP-BASED PLANTATION ESTABLISHMENT

Phases	Duration	Tasks
Awareness raising and social mobilization	3 months	• Constitution of a "village afforestation body" • Identification of afforestation site • Issuance of legal title • Training in raising seedlings, nursery management, and planting
Training, planning, and implementation	8 months	• Planning of work organization • Allocation of individual plots and registration • Soil preparation (mechanized input) • Planting of trees
Self-management	10 months	• Internal and external evaluation • Organizational and technical advice • Creation of sense of responsibility

Source: Sepp 2008a

linking the establishment of charcoal plantations to an incentive scheme, experience from Vietnam and Madagascar suggest that farmers can be supported to ensure that their product meets market requirements (particularly relating to species choice), sound production techniques are adopted, and any negative environmental impacts are avoided (such as the clearance of natural woodlands to make way for planted exotics).

While subsidies and incentive payments may be necessary in the early stages to trigger participation, if this is undertaken together with measures to improve the overall regulation and formalization of the charcoal sector, it is likely that in the longer term, such subsidies may not be needed and can be replaced with more market-based credit provision. As farmers begin to secure financial benefits from the sale of wood for charcoal, it is likely that other farmers will engage in similar activities.

There are opportunities for increasing the efficiency of wood conversion to charcoal. The review of experiences in chapter 3 pointed to the fact that while semi-industrial charcoal kilns may achieve significant efficiencies when compared with traditional earth kilns, they may only be a viable option in large-scale, intensive, plantation-based production enterprises. Extensive production of charcoal in dryland woodland or Miombo areas may well mean that modern, stationary kilns may not be viable. In such circumstances, it is recommended that producers are provided with simple training on how efficiencies of traditional charcoal production (earth kilns) can be improved. Using the experiences gained by TaTEDO in this regard might prove to be a useful option.

The benefits and opportunities generated by the above proposals are summarized as follows.

- Revenue generation from either individual planting of trees or group-based woodland management will increase in areas where other livelihood opportunities are limited.
- Tanzania has an established track record with participatory forest management, and large areas are already legally transferred to community ownership and management, making sustainable woodland management a realistic option.
- Levels of deforestation will be reduced as production shifts to sustainably managed woodlots and community forests.

The following table provides a summary of short- and long-term actions that will be required to implement these actions:

TABLE 4.3 SHORT- AND LONG-TERM ACTIONS TO IMPLEMENT PROPOSED ACTIVITIES

Key Intervention Areas	Short- and Long-Term Interventions	Key Institutions
• Developing harvesting plans for forest areas administered by central or local governments • Securing tenure for rural producers by scaling up community-based forest management in urban catchment areas	Short Term • Identifying forest blocs on village land of sufficient size and condition that would support extensive charcoal management under community management • Undertaking village land-use mapping and planning exercises that secure village land tenure and identify areas of village forest suitable for community management • Developing charcoal harvesting plans in village forests • Supporting selected villages to reserve and declare village land forests • Preparing harvesting plans in local authority and national forest reserves in selected areas • Monitoring harvesting levels to ensure they are in line with agreed off-take levels Long Term • Scaling up to other areas	Forestry and Beekeeping Division National Land Use Commission FBD, PMO-RALG, local governments NGOs with capacity in facilitating PFM (Tanzania Forest Conservation Group, Wildlife Conservation Society of Tanzania, etc)
• Increasing supplies of wood for charcoal through plantations and woodlots	Short Term • Developing a performance-based grant scheme that supports the establishment of plantations • Design of silvicultural packages (seed sources, species, management, etc.) that can be rolled out in target areas • Identifying individuals and groups with significant areas of land and interest in tree planting • Launching grant scheme and ensuring close monitoring and compliance Long Term • Linking producers to markets and technology (improved kilns) and supporting them through fiscal incentives (see above) • Scaling up to other urban charcoal catchment areas	NGO with capacity in tree planting and production, FBD, community groups, individuals Private sector tree growers, support services
• Increasing efficiency of converting wood to charcoal	Short Term • Targeted training support to charcoal producer groups on improvement of traditional practices in areas are supported by other upstream interventions • Assisting individuals and groups with larger tree plantations to identify and invest in improved charcoal kilns	NGOs such as TaTEDO and charcoal producer groups

CHARCOAL CONSUMPTION

Fuel-efficient, domestic charcoal stoves should be promoted. Many of the policy recommendations discussed above would lead to an increase in the final price of charcoal due to the inclusion of raw materials and licensing costs as the sector becomes increasingly regulated. In order to offset any potential hardships created as a result of this anticipated price increase, it is recommended that fuel-efficient domestic charcoal stoves be promoted in urban areas such as Dar es Salaam and Arusha.

The efficiency of most improved (first-generation) domestic stoves is around double that of traditional cook stoves, so adopting such stoves will have a significant impact on reducing domestic expenditure on charcoal. Furthermore, the increase in price will also stimulate urban entrepreneurs in the informal sector to invest in production and marketing. Such initiatives can be supported by external funds from development partners, following lessons learned with the promotion of the Kenya Ceramic Jiko .

Fuel Switching could help to reduce charcoal consumption. Complementary to promoting the adoption of fuel-efficient stoves, efforts to promote fuel switching should continue, although it should be acknowledged that fuel switching alone does not provide the answer to achieving sustainable charcoal consumption. Due to household budget and income constraints, fuel switching is only an option for better-off households, so those should be targeted. But even the better-off households are likely to continue using charcoal for some specific purposes due to culinary or socio-cultural reasons. The promotion of fuel-efficient charcoal stoves then supports the objective of sustainable charcoal consumption.

In this context, it is strongly recommended to evaluate current energy subsidy structures as regards poverty impact and financial sustainability. At the moment, substitute fuels such as LPG must be highly subsidized to be competitive[11]. The need for substantial subsidies creates a long-term foreign exchange burden and negatively influences the country's trade balance. Furthermore, as stated above, only the better-off segments of society benefit from subsidies, because substitute fuels continue to remain too expensive for the poorest households, especially because of the substantial initial investments and maintenance and replacement costs. State subsidies for substitute fuels sends the wrong market signals, as it discourages investment into tree planting or forest management by communities or the private sector.

In addition to focusing strongly on fossil fuel-based substitutes for charcoal like LPG and electricity, it is recommended to further evaluate the promotion of substitute fuels based on biomass. These would not only provide a higher degree of domestic value added, but may also fit better in terms of the socio-cultural aspects of fuel choice. A poor country like Tanzania simply cannot afford to lose a significant number of employment and income opportunities which provide rare occasions for rural people to generate cash income. In the long run, biomass-based substitute fuels are likely to have a better environmental impact than fossil fuel-based substitutes for charcoal.

There are opportunities for commercially viable briquetting. Experiences from briquetting initiatives elsewhere suggest that if commercially viable production operations are to work in an economically viable manner and achieve significant levels of production without external support or subsidies, great care must be taken in selecting the raw materials for carbonization, as well as identifying suitable niche markets. Within Tanzania, there are already some experiences producing and marketing briquettes. Examples from other countries include Chardust Ltd. in Kenya, which takes advantage of the ready supplies of waste charcoal dust (or sawdust). A more in-depth feasibility study would be needed before potential investors could be approached.

Since briquetting uses identical combustion techniques as charcoal, briquetting represents a complementary fuel, rather than a fuel switch. Briquette use can reduce the amount of charcoal used by an individual household, without requiring significant equipment changes. Therefore, it generally does not require major investments in new technologies and—depending on the availability—households can easily switch back and forth between charcoal and briquettes. Due to this complementary nature, briquetting is not included in the discussion regarding the economic costs of fuel switching.

The benefits and opportunities generated by the above proposals are summarized below. They would create:

- increased urban employment through increasing production and trade of improved domestic stoves; and
- reduced expenditure on energy by a wide cross section of urban households that depend on charcoal as a primary energy supply.

The following table provides a summary of short- and long-term actions that will be required to implement these actions:

[11] At the moment LPG is exempt from any VAT and import tariffs.

TABLE 4.4 SHORT- AND LONG-TERM INTERVENTIONS WITH THE OBJECTIVE OF REDUCING CHARCOAL CONSUMPTION

Key Intervention Areas	Short- and Long-Term Interventions	Key Institutions
• Promotion of fuel-efficient, domestic charcoal stoves	Short Term • Identifying suitable designs from other countries (e.g. Kenya) • Training informal artisans to produce quality stoves • Marketing support Long Term • Expansion to other urban centers	Informal artisans in the private sector, NGOs
• Exploring opportunities for commercially viable briquetting • Fuel switching	Short Term • Undertaking market survey for possibility of briquetting in Dar es Salaam or Arusha • Linking entrepreneurs to financing sources	Private sector enterprises

CHAPTER 5 IMPACT AND COST OF PROPOSED POLICY REFORMS

IMPACT OF PROPOSED POLICY REFORMS ON DEFORESTATION

The primary goal of the proposed policy interventions is to reduce deforestation caused by unregulated trade in charcoal. Given this, it is important to assess how the different policy options presented above could potentially impact forest and tree cover on a national or regional scale. In this section, the impact of a number of key interventions is explored by using a simple modeling tool developed for this purpose, and comparing this with a "Business-as-Usual" (BAU) scenario (if no action was taken). The assumptions used, and the detailed workings of this model, are presented in annex 2, and a more detailed analysis of policy impacts is presented in annex 3. The summary of conclusions is presented below.

The impacts of four policy interventions were reviewed: the promotion of fuel switching, the introduction of fuel-efficient charcoal stoves, improved charcoal production kilns, and afforestation/reforestation measures designed to increase the supply of woody biomass.

Some of the key findings were as follows.

- Assuming an adoption rate of 5 percent per annum for fuel switching and energy-saving stoves, these two interventions combined would lead to a reduction in demand for charcoal in the Dar es Salaam market of around 63 percent per annum when compared with a BAU scenario. However, when the effects of projected population increases are factored in, this figure declines.
- When these two interventions are combined with the introduction and promotion of improved kiln technology, which could realistically increase efficiency from 10 percent to 15 percent, a significant impact was observed on forest resources. The relatively larger impact of improved kilns on forest cover, as compared to other consumption-related policy options, may be explained by the fact that this intervention is not negatively affected by population increases.

Figure 5.1 presents a graphical comparison of how different policy interventions may—either singly or in combination—affect forest cover around Dar es Salaam. The graph indicates that over the 20-year period used in this model, an afforestation or reforestation initiative amounting to almost 800,000 hectares would be necessary to compensate for the loss of natural forests over this period. It is important to note that this model only provides indications, and cannot account for a range of unforeseen factors. One such factor is the possible expansion of charcoal harvesting and transport to a wider area. It is likely that as supplies diminish around the capital, traders will be forced to travel ever greater distances to obtain quality charcoal. Given the increases of fuel prices seen in recent years, this may also impact pricing charcoal. Furthermore, the model does not take account other potential land uses, such as the expansion of commercial agriculture (for use as biofuels), and the impact this may have on land availability (for planting and reforestation), as well as the supply of wood due to heavy land clearance.

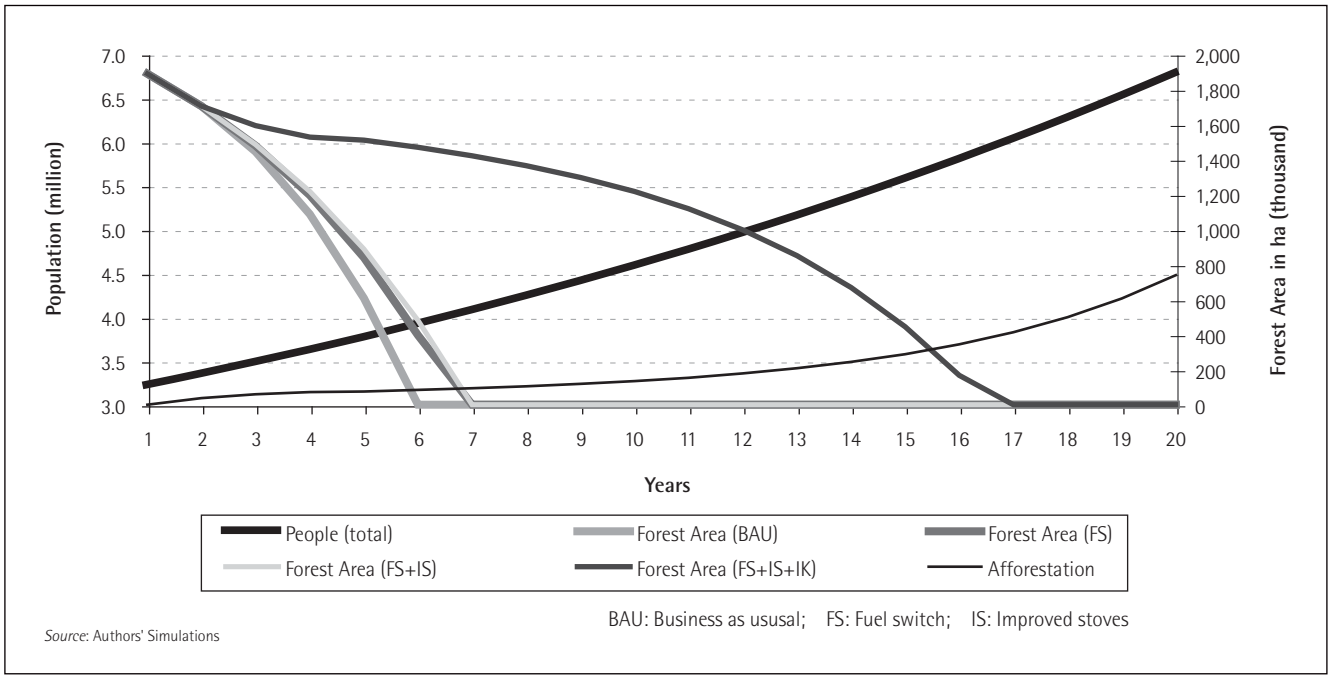
In summary, the simulations presented above and in annex 3 suggest that:

- increased kiln efficiency would play an important role in achieving a reduction of overall wood quantities needed for charcoal production, while the promotion of fuel switching would mainly buffer against a further increase in demand due to an increase in population.

- afforestation and the sustainable management of forests through PFM would be required to compensate for a continued loss and degradation of existing natural forests. Fiscal incentives might play an important role in achieving this goal.

- no single intervention, implemented alone, would have a significant impact on reducing deforestation. Rather, measures must be implemented together and in a mutually supportive manner along the supply-demand chain if tangible results are to be achieved.

FIGURE 5.1 PROJECTED IMPACT OF POLICY OPTIONS ON FOREST COVER AROUND DAR ES SALAAM



Source: Authors' Simulations

IMPACT OF FISCAL REFORMS ON CHARCOAL PRICING

Fiscal reforms have been proposed as a means of incentivizing sustainable charcoal production and penalizing illegal, unregulated, and unsustainable trade. The real costs of charcoal production, when undertaken in a regulated and sustainable manner, include a range of costs including afforestation, forest management and protection, silviculture, and all fees for licensing and transport. Figure 5.2 illustrates how fiscal incentives can be used to balance the costs of regulated charcoal with those of illegal charcoal, which does not incur any of these charges. If the tax charged on unregulated charcoal is equal to the costs involved in sustainable wood production, the market price would be equal, and sustainable charcoal would become competitive in the market. These simple scenarios do, however, assume that government is able to effectively address the widespread, unregulated market, and to impose taxes upon this trade. Traders currently employ a range of techniques to evade licenses and taxes, including traveling at night, and widespread bribery and corruption at checkpoints. Clearly, these are challenges that will require significant investment and political will if they are to be overcome.

Scenario 1 in figure 5.2 presents the situation as it currently exists in Tanzania. Market prices for unsustainably produced charcoal only reflect costs for exploitation, carbonization, and

FIGURE 5.2 FISCAL INCENTIVES FOR SUSTAINABLE CHARCOAL PRODUCTION (SCENARIO 1 AND 2)

Scenario 1: Business-as-Usual (BAU)

	Production	Exploitation & Carbonisation	Transport	Market Price
Nonsustainable Scenario	0	120	40	160
Sustainable Scenario	150	80	20	250

Scenario 2: Introduction of Sustainability Tax

	Production	Exploitation & Carbonisation	Transport	Taxes	Market Price
Nonsustainable Scenario	0	120	40	90	250
Sustainable Scenario	150	80	20	0	250

Illustrative example; no specific currency or %-based tax rate

Source: Adapted from Sepp 2008b

transport, but not for sustainable wood production via natural forest management or through tree planting. Charcoal produced sustainably will be sold at a higher market price, and as a result cannot be competitive on the market, because consumers will always opt for the cheapest product. Scenario 2 illustrates how a sustainability tax can be introduced to discriminate against charcoal that is produced using unsustainable practices.

The disadvantage of a sustainability tax is that it would increase market prices for consumers. Consumers are already suffering from high market prices for charcoal, leaving little room—especially for the poorest households—to adjust their consumption patterns. Therefore, an increase in market price has a direct, negative impact on the poorest people, which can only be addressed by reducing household consumption.

One measure to compensate for increased market prices, however, is the use of fuel-efficient stoves. As illustrated in Scenario 3 of figure 5.3, the use of fuel-efficient stoves could theoretically compensate for increases in market prices, resulting in market prices that are equivalent to those under unsustainable charcoal production.

FIGURE 5.3 IMPACT OF IMPROVED STOVES ON FUEL COSTS

Scenario 3: Promotion of Fuel-Efficient Stoves

	Production	Exploitation & Carbonisation	Transport	Taxes	Charcoal Savings	Market Price
Nonsustainable Scenario	0	120	40	90	-40%	160
Sustainable Scenario	150	80	20	0	-40%	160

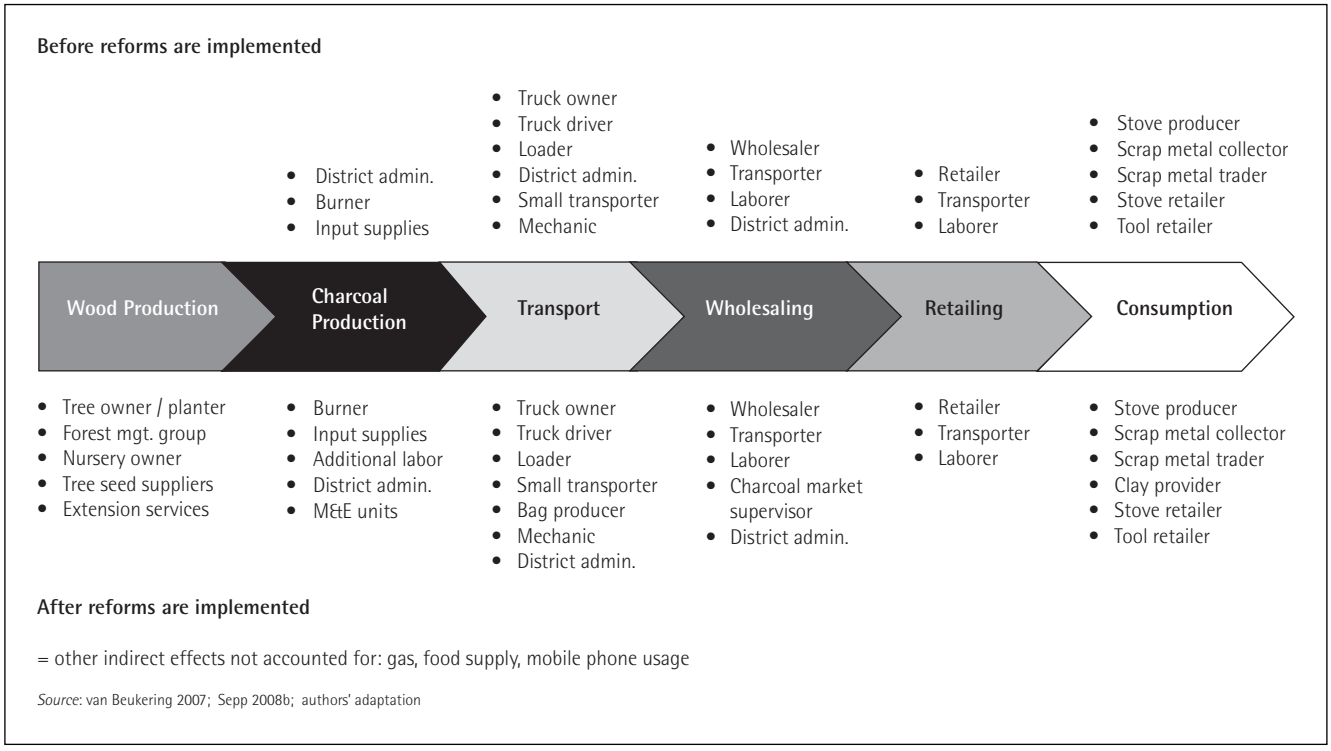
Illustrative example; no specific currency or %-based tax rate

Source: Sepp 2008b

IMPACT OF REFORMS ON LIVELIHOODS AND EMPLOYMENT

Formalizing the charcoal value chain has the potential to provide new economic opportunities for rural households. Figure 5.4 illustrates potential new beneficiaries of these measures along the production–trade– consumption chain. One area that is particularly likely to experience growth and opportunities is the production of wood for charcoal through afforestation and reforestation.

FIGURE 5.4 BENEFICIARIES IN THE CHARCOAL VALUE CHAIN (BEFORE AND AFTER REFORM)



Source: van Beukering 2007; Sepp 2008b; authors' adaptation

In addition to an increase in the projected number of beneficiaries anticipated following a reform of the charcoal sector, it is likely that an additional advantage would be a more even distribution of benefits among all stakeholders involved in charcoal production, trade, and marketing. However, this might equally be one of the largest barriers that needs to be overcome, as the strong vested interests of local elites, who benefit disproportionally from the status quo, are not easily changed. Additional investments will be required to support capacity building and incentive structures at the district level that are aimed at improving transparency, as well as wider moves toward improved law enforcement and governance in the overall forest sector.

COMPARISON OF POLICY OPTIONS

Table 5.1 summarizes the key aspects of the policy options discussed in this paper.

TABLE 5.1 COMPARISON OF ALTERNATIVE POLICY OPTIONS

Policy Option	Impact on Charcoal	Opportunities	Risks
Consumption			
Improved Stoves	• Reduces the amount of charcoal households use to satisfy energy needs for cooking • Households will continue buying charcoal	• Households can save expenses for charcoal when prices increase • Being domestically produced, It will continue to support the economy and local economic development	• Adoption rates have been reported to be low in the past • Factors were: costs, durability, handling of stove, etc. • Overall charcoal consumption may still increase, depending on demographics
Fuel Switch	• Households will stop using charcoal	• Charcoal consumption will significantly decrease • Tanzania has good supplies of natural gas	• Some alternative fuels have to be imported • Dependence on international market prices increases • Alternative fuels do not have the same employment opportunities for rural, poor people • Forests will lose value for rural people
Trade			
Regularisation	• Charcoal trade take place within clearly defined structures and systems • Charcoal operators will cease operating in a "grey" zone of unclear rights and regulations • Charcoal will increasingly be sourced from sustainable production systems and unsustainable production will drop	• Revenue collection will increase, providing resources for reinvestment at district & national government levels • Regularized trade is a precondition for introducing fiscal incentives • Monitoring of trade can be improved with positive FLEG* impact • Charcoal operators will cease operating in a "grey" zone of unclear rights and regulations • It will become easier for small-scale wholesalers & traders to participate	• Resistance by vested interest groups fearing a loss of market power, market shares, and rents
Fiscal Incentive	• Fiscal incentives encourage investments in sustainable forest management and treeplanting	• Those investing in tree planting and sustainable forest management will be compensated for their investments • Unsustainable practices will be penalized, but not prohibited	• Resistance by vested interest groups fearing a loss of market power, market shares, and rents
Conversion			
Improved Kilns	• Reduces the amount of wood needed for producing a given unit of charcoal	• Improved kiln efficiency has a high impact on reducing pressure on forests • Relatively easy to implement with known technology	• Labor intensive • Additional costs only feasible under a regularized charcoal sector • May also require fiscal incentives to justify higher investments • Requires good monitoring for compliance

*FLEG = Forest Law Enforcement and Governance

Policy Option	Impact on Charcoal	Opportunities	Risks
Production			
Participatory Forest Management (PFM)	• The potential of natural forests will be increased to produce charcoal sustainably through management plans, management interventions, and controlled access	• Tanzania has a good track record of PFM • Anchored in national forest management strategies • Knowledge is available	• Capacities too low to achieve PFM at a scale that is needed given the extent of charcoal production required • Remaining unreserved forest patches are small and degraded and will require restoration before harvesting can begin
Plantations	• Increased wood production through intensively managed plantations, including small-scale woodlots	• Increased revenue for rural people • Introduction of sustainable land-management techniques for degraded areas • Increase in efficiency of wood production	• Unclear land and tree tenure • Investment costs (may only work in line with fiscal incentive system) • May require external financial input • Low capacity in regard to technical input through extension services

ESTIMATING COSTS OF POLICY REFORMS

This section presents rough estimates of targeted investments along the charcoal value chain that would be required to change the current unsustainable use of forest resources for charcoal utilization into a sustainable, formal sector of the economy.

TABLE 5.2 INDICATIVE INVESTMENT COSTS FOR SUSTAINABLE CHARCOAL PROGRAM

Component	Activities	Estimated Amount (in US$)
Forest Management	Scaling up of PFM in natural forests in districts affected by charcoal production for Dar es Salaam (about 2 million hectares)	12,000,000
	Inventories of forest areas in districts near Dar es Salaam	3,000,000
	Establishment of management plans for sustainable annual harvests	500,000
	Facilitation of the work of district harvesting committees	500,000
	Promotion of reforestation & afforestation activities (40,000 hectares at US$250 per hectare; 8,000 hectares per year)	10,000,000
	Promotion of agroforestry systems and trees-outside-forests resources	1,500,000
	Establishment of capacity building program at community level (through local NGO)	1,000,000
	Development and implementation of communication program regarding charcoal	1,000,000
	Intensification of monitoring of management plans and harvesting	1,000,000
	SUBTOTAL	**28,500,000**
Carbonization	Review existing rules and regulations regarding kiln technologies	200,000
	Scaling up capacity building for improved kiln technologies	1,000,000
	Intensify monitoring efforts to comply with rules & regulations	750,000
	SUBTOTAL	**1,950,000**
Trade & Wholesaling	Construction/improvement of permanent checkpoints along main roads leading to Dar (2 at each main road = 6 total)	600,000
	Construction of central marketing posts in each district (3 in each district = 9 total)	1,000,000
	Construction of charcoal market infrastructure (3 markets in each district in Dar es Salaam = 9 total)	1,800,000
	Piloting fiscal incentive scheme (e.g. nonreusable bags, vouchers)	2,000,000
	SUBTOTAL	**5,400,000**
Consumption	Program to improve stove technology	500,000
	Intensify dissemination of information, marketing campaigns for improved stoves	1,500,000
	Intensify dissemination of information, marketing campaigns for fuel switching	1,500,000
	Market research regarding alternative energy sources	250,000
	Poverty & Social Impact Analysis of fuel switching alternatives	200,000
	Scaling up capacity building of alternative fuel options and usage	500,000
	SUBTOTAL	**4,450,000**
	TOTAL	**40,300,000**

Source: Authors' calculation

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ANNEXES

Annex 1
Common Misconceptions about Wood Energy

Annex 2
Structure of Simulation Model Used in this Policy Note

Annex 3
Impact of Various Policy Options on Deforestation Rates

ANNEX 1 COMMON MISCONCEPTIONS ABOUT WOOD ENERGY

The importance of wood as a sustainable energy supply option and the problems associated with it are largely undervalued by planners and policy makers. Various widespread misconceptions hamper the development of the wood energy sector. The following are some examples.

ANNEX BOX 3.1 COMMON MISCONCEPTIONS ABOUT WOOD ENERGY

Wood is not very widely used as an energy source	In fact, wood supplies about 90% of Tanzania's energy demands. This is mostly in the form of charcoal and firewood
Wood fuels are phasing out	No. In many countries the consumption of wood and other biomass fuels is still increasing in absolute terms, even when their share in national energy consumption is decreasing.
Wood fuel has little value	No. The total value of the charcoal trade in Dar es Salaam is valued at US$350 million per year
Only poor and rural households use wood fuel	Surveys have shown that in many towns and even in some metropolitan areas, wood fuels are widely used by both low- and high-income groups.
Wood fuel is a traditional commodity only	Generally not. Modern applications use modern fuels, which largely complement traditional fuel use.
Wood fuels are being substituted by modern fuels	At present, modern technologies are increasingly being applied to wood fuel development. Many industrialized countries are deliberately increasing wood energy use, for environmental and socioeconomic reasons.
Most wood fuel originates from forests	This conflicts with many survey results revealing that some two-thirds of all wood fuels originate from areas outside forests.
Fuelwood is collected for free	Some is, but a lot is not!
Wood fuels are a gift from nature and do not need to be managed or produced	Many people, particularly in Asia, treat fuelwood as a commodity that can be, and indeed partly is, produced and harvested like rice or wheat, though with a much longer growth period.
Wood fuel production is a marginal subsector	Wood fuel business is the main source of income for about 10% of rural households, supplying about 40% of their cash earnings. Wood fuel use generates at least 20 times more local employment than energy from oil products (per unit of energy).
Wood energy cannot be planned because of lack of data	Indicative planning does not require a full set of data. This type of planning can be used in policy making.
Burning wood adds more CO2 to the atmosphere than oil	Sustainable regrowth of wood fuel captures the CO2 back from the atmosphere. The net effect on the global atmosphere is zero, unlike that of fossil fuels.
With respect to renewable forms of energy, R&D should focus on solar, wind, and hydro energy	Wood energy is renewable. Of the various renewable sources of energy, wood provides the largest share by far!

Source: Adapted from Regional Wood Energy Development Programme (RWEDP) 1997

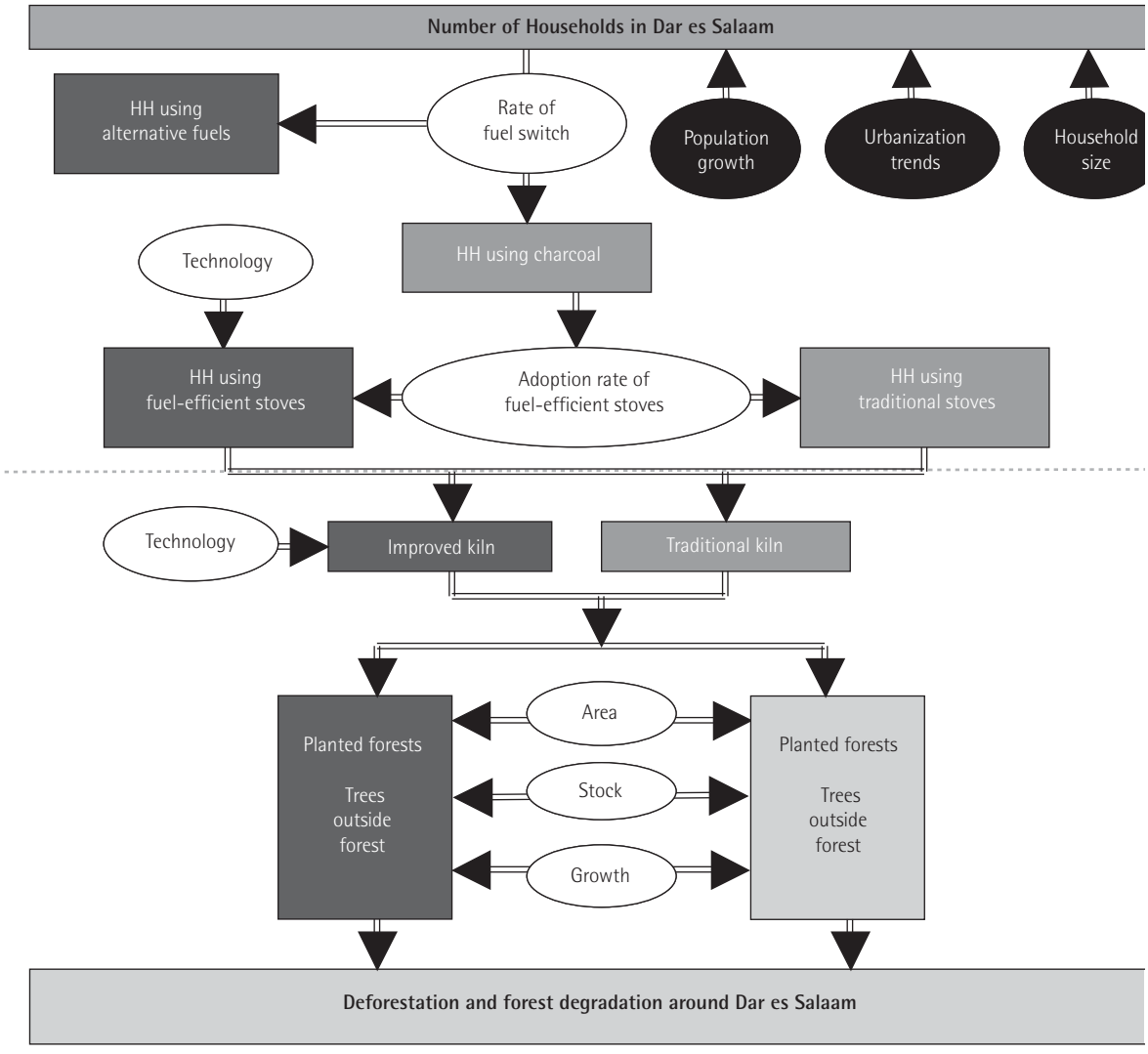
ANNEX 2 STRUCTURE OF SIMULATION MODEL USED IN THIS POLICY NOTE

The importance of wood as a sustainable energy supply option and the problems associated with it are largely undervalued by planners and policy makers. Various widespread misconceptions hamper the development of the wood energy sector. The following are some examples.

A simple spreadsheet model has been developed using Microsoft Excel to simulate how household demand for cooking energy impacts forest resources, and how different policy interventions may change the current situation. The model was developed for Dar es Salaam, for two principle reasons.

- Reliable data already exists for this area from established secondary sources;
- Dar es Salaam accounts for over half of Tanzania's charcoal consumption. Charcoal production is frequently reported as one of the main drivers for deforestation and forest degradation in the regions adjacent to the city where charcoal supplies originate.

ANNEX FIGURE 2.1 CONCEPTUAL FRAMEWORK OF THE SIMULATION MODEL



Source: Authors

The objective of this modeling exercise was to simulate the impacts of different policy options on overall forest cover and deforestation. The flowchart presented above summarizes the main variables and parameters of the model, and how they are interlinked. Variables that cannot be changed through policy intervention are shown in rectangles, while parameters that can be changed through policy interventions are in circles.

The model's main basic variable is the number of households (HH) in Dar es Salaam. This number is influenced by three parameters: population growth, urbanization trends, and average household size. Because these parameters are exogenous to the discussion of this policy note they are shown in grey.

At the moment, a certain share of households use charcoal, while others use alternative fuels. This share can be influenced by the rate with which households switch from charcoal to alternative cooking fuels. This parameter is again a function of several factors, such as household income, education, availability of alternative fuels, upfront investment, and household size. Due to the complexity of the impacts of and interactions among these factors, the rate of fuel switching was not modeled, but only an average representative number was assumed.

Those households that use charcoal have a choice between using a traditional stove, or an improved, fuel-efficient stove. Adoption rates of improved stoves are a function of many factors, but for the purpose of this exercise, a rate was selected that is in line with observed rates. The efficiency increase of improved stoves compared to traditional stoves was assumed, based on data presented in existing literature.

Until this point, the model considers variables and parameters influencing the total amount of charcoal consumed by households in Dar es Salaam. The next step is to simulate how charcoal quantities translate into wood-equivalent volumes, and eventually, hectares of forest exploited. In this context, the parameters assumed for the carbonization process play an important role in determining the final outcome.

The model differentiates between the carbonization efficiencies of traditional kilns and improved kilns. It is frequently stated that kilns most widely used in Tanzania are the most basic, and hence the most inefficient, with efficiencies not greater than 10 percent. Increased efficiency rates for improved stoves were taken from recent literature on the subject.

The final step in simulating the impact of charcoal consumption on deforestation looks at the productivity of forest resources from either natural or planted areas. Three parameters are identified: forest area (in square meters), standing stock (in cubic meters per hectare), and tree growth rates (in cubic meter per hectare per year)—all of which can potentially be altered through policy intervention. For example, the promotion of participatory forest management (PFM) can positively impact the standing stock and growth rates of natural forests. For all of these parameters, reliable data is found in current forestry literature in Tanzania. It should be noted that for planted forests, growth parameters for fast-growing tree species, such as eucalyptus or pine, are considered, because farmers have been observed to prefer these over slower-growing indigenous species.

In summary, seven variables (shown in white in annex figure 2.1) have been considered for this simulation model, all of which influence the final outcome of the model, and all of which may be affected by policy interventions. Three additional variables (shown in black in annex figure 2.1) have been included that influence the total number of households in Dar es Salaam (See table annex 2.1). These 10 variables all interact with one another, creating either mitigating or multiplier effects. For example, efficiency increases in kiln technology are reported to have a larger effect on sustainable charcoal production than fuel switching or adoption of fuel-efficient stoves, because the effect of the latter is partly offset by population increases.

The deforestation simulated in this model is assumed to originate solely from the exploitation of wood for charcoal production. This is a major simplification, since other, more permanent land-use changes also occur in parallel, such as the extension of agricultural land or the growth of settlement areas. Modeling these effects would have added a level of complexity that would have been beyond the scope of this policy note. Therefore, the results generated through this model should be considered as indicative only, serving as a basis for discussion when evaluating the rationale for applying different measures under the umbrella of a comprehensive policy approach.

The model, its parameters, and its projections, rest on a large number of assumptions. Projecting future trends has been done largely by extrapolating historical data, which is a far from perfect approach. Many additional factors and variables—which are unknown today or at least not yet analyzed sufficiently— are not considered in this model, and may have a significant influence on overall simulation results. For example, increasing charcoal demand, coupled with decreasing availability of wood for charcoal production near urban centers, is likely to lead to an increase in price. Evidence from Tanzania and elsewhere, however, suggests that charcoal prices are affected by a wide number of variables beyond simple supply–demand relationships. One such example is the recent increase in the price of imported fossil fuels, which would tend to increase transport costs, as well as increase the cost of alternative fuels such as gas or kerosene.

A number of authors have, and continue to question, the conventional wisdom of receding woodland frontiers due to their exploitation for charcoal production. Small changes in land management practices, regeneration rates, and disturbance levels, combined with incomplete assessments of all woody biomass (including trees outside forests) may combine to produce a more complex mosaic of land use and land-use change. Despite these complications, it is clear that the production of charcoal is often the first step in a process of degradation, as forested land is gradually converted to other land uses such as agriculture. Degradation (as compared to deforestation) is often much more difficult to observe through interpretation and analysis of aerial photographs, but still has significant negative impacts on rural livelihoods and the supply of environmental services. The importance of preventing forest degradation has recently been acknowledged in the context of greenhouse gas emissions and the role of forests in mitigating climate change.

ANNEX TABLE 2.1 SUMMARY OF ASSUMPTIONS FOR MODEL PARAMETERS

Parameter	Value	Source
Annual population growth	4.0%	Conservative estimation based on various studies indicating growth rates between 3.5% and 5.0% for Dar es Salaam
Urbanization	-	Included in assumption for population growth
Average HH size	4.5	Household Budget Survey 2007
Share of HH using charcoal	71%	Household Budget Survey 2007
Annual rate of fuel switching	5%	Assumed; contingent on success of policy measures; optimistic assumption given that over the past years no effective fuel switching has been reported
Annual reduction of fuel switching	15%	Assumed
Share of HH adopting improved stoves	5%	Assumed; contingent on success of policy measures; optimistic assumption given that over the past years it was observed that HH resist investing in improved stoves
Annual reduction of adopting improved stoves	15%	Assumed
Efficiency of improved stoves	25%	Assumed; see table 3.2
Kiln efficiency traditional kiln	10%	Assumed; see table 3.1
Annual increase in kiln efficiency	20%	Assumed
Maximum improved kiln efficiency	15%	Assumed; see table 3.1
Stock of natural forests	10 m3/ha	CHAPOSA 2002, Luoga et al. 2002
Growth rate of natural forests	2.5 m3/ha/year	CHAPOSA 2002, Luoga et al. 2002
Growth rate of planted trees	50 m3/ha/year	Based on growth rates of fast-growing eucalyptus plantations

ANNEX 3 IMPACT OF VARIOUS POLICY OPTIONS ON DEFORESTATION RATES

Two primary interventions can be identified to reduce the quantity of charcoal used by end consumers: promoting a switch to alternative fuels for cooking, and promoting the adoption of improved, fuel-efficient stoves. Both of these policy options have been tried in a range of circumstances, with varying degrees of success. Nevertheless, relatively optimistic assumptions have been applied to the model by assuming an adoption rate of 5 percent in terms of the annual rate of households switching to alternative fuels, and a 5 percent annual adoption rate of households adopting fuel-efficient stoves. Both rates have been assumed to decline by 15 percent annually to account for decreasing switching and adoption rates over time.

ANNEX TABLE 3.1 SIMULATED IMPACT OF FUEL SWITCH AND ADOPTION OF IMPROVED STOVE ON CHARCOAL CONSUMPTION FOR DAR ES SALAAM

	Year				
	1	5	10	20	Units
Business-as-Usual					
HH using charcoal	71%	71%	71%	71%	
Volume of charcoal	27,298	32,581	40,646	63,259	bags / day
Fuel Switch					
HH using charcoal	71%	59%	48%	31%	
Volume of charcoal	27,298	27,171	27,281	27,501	bags / day
Fuel Switch + Improved Stoves					
Volume of charcoal	27,298	26,088	25,074	23,638	bags / day

Assumed Parameters for Fuel Switch (FS)

*Annual rate of FS	5%
*Annual reduction of FS rate	15%

Assumed Parameters for Adoption of Improved Stoves (IS)

% households adopting IS	5%
Annual reduction of adopting IS	15%
Stove efficiency (traditional stove vs IS)	25%

Annex table 3.1 provides two important conclusions.

- Compared to current consumption levels, no significant reduction of charcoal use can be achieved with either intervention. While switching fuel alone only results in a reduction of about 3 percent compared to current consumption levels,[[the table above shows volume of charcoal increasing with time]] fuel switching plus the adoption of improved stoves combined leads to an overall reduction of about 13 percent.

- Compared to the Business-as-Usual (BAU) scenario, (where charcoal consumption continues as currently observed, with 71 percent of households using charcoal), the impacts are significant, with reductions of about 56 percent for fuel switching and reductions of 63 percent for fuel switching combined with adoption of improved stoves.

The above simulation demonstrates the important impact population growth has on absolute consumption levels. Even if fuel switching and the adoption of improved, fuel-efficient stoves can be successfully introduced, much of the impact on absolute levels of demand will be offset by population growth. The successful implementation of these two policy options alone will not be sufficient to achieve significant impacts on reducing deforestation or degradation rates, but can only be expected to buffer against future increases of charcoal consumption.

A third possible policy intervention that can positively impact the use of wood for charcoal production is improving kiln efficiency so that more charcoal can be produced with a given quantity of wood. At the moment, kiln efficiency in Tanzania is very low, estimated at only 19 percent. For the purposes of this simulation model, it is assumed that kiln efficiency can be increased by 15 percent.

ANNEX TABLE 3.2 IMPACT OF IMPROVED KIN TECHNOLOGY ON FORESTS

	Year				
	1	5	10	20	Units
Forest Area under BAU Scenario					
	1,887,369	607,640	0	0	hectare
Forest Area with Policy Intervention					
A) Traditional Kiln					
Fuel Switch	1,887,369	838,982	0	0	hectare
Fuel Switch + Improved Stoves	1,887,369	886,701	0	0	hectare
B) Improved Kiln*					
Fuel Switch	1,887,369	1,474,745	921,141	0	hectare
Fuel Switch + Improved Stoves	1,887,369	1,508,616	1,215,381	0	hectare

***Applied Conversion Parameters**	
Kiln Efficiency (traditional kiln)	10%
Assumed annual increase in kiln efficiency	20%
Maximum kiln efficiency assumed for improved kiln	15%
Conversion factor wood weight => Volume (ton => m3)	0.85

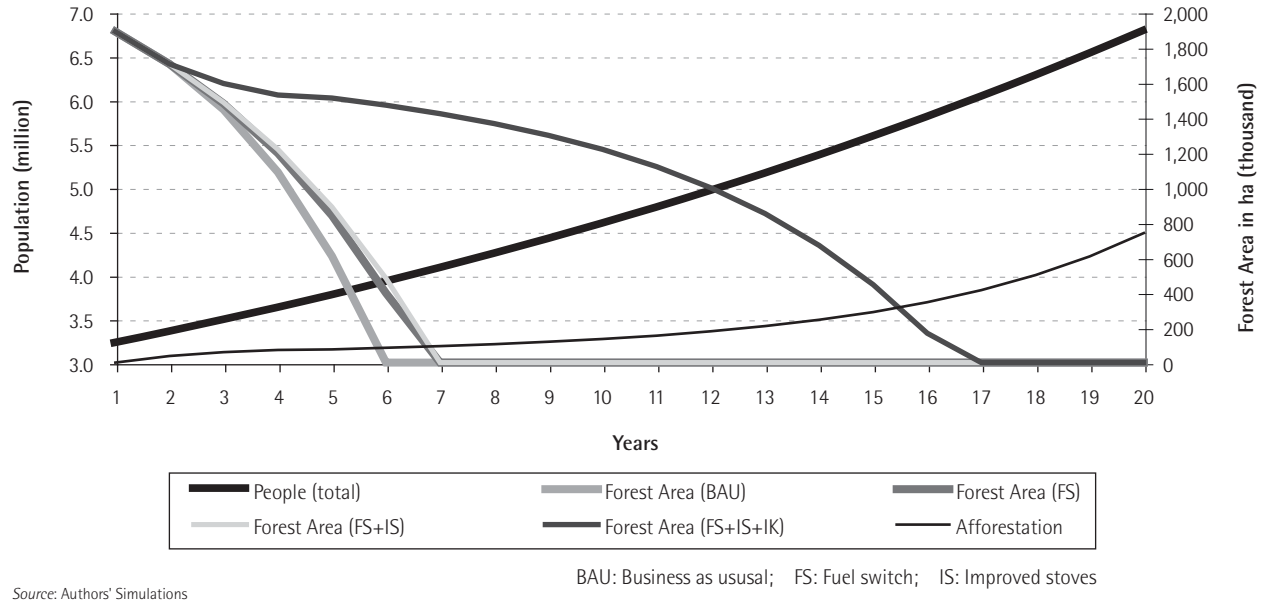
Assumed Forest Parameters Natural Forests (Miombo Woodland)	
Stock per hectare	10
Growth per hectare per year	2.5

Annex table 3.2 illustrates the combined and individual impacts of the three policy options on forest cover. It can be seen that improved kiln technology—although only increasing efficiency from 10 percent to 15 percent—has a significant positive impact on forest area. The relatively larger impact of improved kiln technology on forest management, compared to policy interventions on the consumption side, can be explained by the fact that production-side measures are not offset by population growth and, thus, have a more profound impact.

Annex figure 3.1 presents a graphical comparison of how different policy interventions might either singly, or in combination, affect forest cover around Dar es Salaam. The graph indicates that over the 20-year period used in this model, an afforestation or reforestation initiative amounting to almost 800,000 hectares would be necessary to compensate for the loss of natural forests over this period. It is important to note that this model provides indications only and cannot account for a range of unforeseen

factors. One such factor is the possible expansion of charcoal harvesting and transport to a wider area. It is likely that as supplies diminish around the capital, traders would be forced to travel ever greater distances to obtain quality charcoal. Given the increases in fuel prices seen in recent years, this might also impact charcoal pricing. Furthermore, the model does not take into account other potential land uses, such as the expansion of commercial agriculture (such as for biofuels), and the impact this might have on land availability (for planting and reforestation), as well as the supply of wood due to heavy land clearance.

ANNEX FIGURE 3.1 PROJECTED IMPACT OF POLICY OPTIONS ON FOREST COVER AROUND DAR ES SALAAM



Source: Authors' Simulations

In summary, the simulations presented above suggest that:

- increased kiln efficiency plays an important role for achieving a reduction of overall wood quantities needed for charcoal production, while the promotion of fuel switching will mainly buffer against a further increase in demand due to an increase in population.

- afforestation and the sustainable management of forests through PFM will be required to compensate for a continued loss and degradation of existing natural forests. Fiscal incentives may play an important role in achieving this goal.

- No single intervention, implemented alone, will have a significant impact on reducing deforestation. Rather, measures must be implemented together and in a mutually supportive manner along the supply-demand chain if tangible results are to be achieved.

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