Criteria and indicators for sustainable woodfuels

Case studies from Brazil, Guyana, Nepal, Philippines and Tanzania

CRITERIA AND INDICATORS FOR SUSTAINABLE WOODFUELS

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Acronyms

AC	Acre
ADB/OECF	Asian Development Bank/Overseas Economic Cooperation Fund
AFC	The Austrian Students
AMS	Associacao Mineira de Silvicultura
ANSAB	Asia Network for Sustainable Agriculture and Bio-Resources
APFC	Asia Pacific Forestry Commission
A/R	Afforestation/ Reforestation
ATO	African Timber Organization
BA	Bahia
BERC	Biomass Energy Resource Center
BRACELPA	Brazilian Pulp and Paper Corporation
BZCF	Buffer Zone Community Forest
BZCF	Buffer Zone Community Forest
CBD	Convention of Biological Diversity
CBFM	Community-based Forestry Management
CBFMA	Community-based Forestry Management Agreement
CBO	Community Based Organization
CDC	Commonwealth Development Cooperation
CDM	Clean Development Mechanism
CE	Ceara
CF	Community Forest
CHAPOSA	Charcoal Potential in Southern Africa
CIFOR	Center for International Forestry Research
C&I	Criteria and Indicators
CME	Coconut fatty acid methyl ester
CO2	Carbon dioxide
CONPET	National Programme of Rationalization of Petroleum Derivatives and Natural Gas
CSA	Canadian Standards Association
CVRD	Companhia Vale do Rio Doce
DA	Department of Agriculture
DAP	Development Academy of the Philippines
DAR	Department of Agrarian Reform
DDC	District Development Committee
DENR	Department of Environment and Natural Resources
DFO	District Forest Officer
DFPSC	District Forest Products Supply Committee
DOE	Department of Energy
DOF	Department of Forests
DOST	Department of Science and Technology
ERB	Energy Regulatory Board
ESMAP	Energy Sector Management Program
FAO	Food and Agriculture Organization of the United Nations
FBD	Forestry & Beekeeping Division
FCS	Family Consumption Survey
FD	Field Document
FECOFUN	Federation of Community Forest Users Nepal
FMB	Forest Management Bureau

FMP	Forest Management Plan
FMU	Forest Management Unit
FPDB	Forest Products Development Board
FSC	Forest Stewardship Council
FSMP	Forestry Sector Master Plan
FUG	Forest Users Group
GDP	Gross Domestic Product
GFC	Guyana Forestry Commission
GHG	Greenhouse Gas
GIS	Geographic Information System
GJ	Giga Joule
GoG	Government of Guyana
HDI	Human Development Index
HECS	Household Consumption Survey
IBAMA	Instituto o Brasileiro do Meio Ambiente e dos Recursos Naturais Renovaveis
IBIGE	Brazilian National Statistics Agency
IEA	International Energy Agency
IHEP	Integrated Human Ecology Project
INEE	Instituto Nacional de Eficiencia Energetica
IPED	Institute for Private Investment Development
ITTC	International Tropical Timber Council
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
JAFTA	Japan Forest Technical Association
JBIC	Japan Bank for International Cooperation
KFW	Kreditanstalt für Wiederaufbau, (*Reconstruction Credit Institute*)
LEI	The Indonesian Ecolabelling Institute
LGU	Local Government Unit
LHF	Lease Hold Forest
LPG	Liquefied Petroleum Gas
LSGA	Local Self Governance Act
MAI	Mean Annual Increment
MEM	Ministry of Energy and Minerals
MFSC	Ministry of Forests and Soil Conservation
MGJ	Million Giga Joule
MLHSD	Ministry of Lands and Human Settlement Development
MMBFOE	Million barrels of oil equivalent
MME	Ministry of Energy and Mines
MNRT	Ministry of Natural Resources and Tourism
MOF	Ministry of Finance
MPFD	Master Plan for Forestry Development
MTCC	Malaysian Timber Certification Council
MTOE	Million tons of oil equivalent
MT	Mato Grosso
MT	Metric tons
MTCC	Malaysian Timber Certification Council
MW	Mega watt
NAPOCOR	National Power Corporation
NDS	National Development Strategy

NFA	Nepal Foresters' Association
NEA	National Electrification Administration
NGO	Non-Government Organization
NPC	National Power Corporation
NRE	Non-Renewable Energy
NSCB	National Statistics Coordinating Board
NSO	National Statistics Office
NTFP	Non-Timber Forest Products
NWFP	Non-wood forest products
PA	Para
PEFC	Program for the Endorsement of Forest Certification
PEP	Philippine Energy Plan
PFE	Permanent Forest Estate
PHP	Philippine Peso
PJ	Peta Joule
PR	Parana
PRESSEA	Promotion of Renewable Energy Sources for Southeast Asia
RA	Republic Act
RE	Renewable Energy
RETRUD	Renewable Energy Technology for Rural Development
RLDC	Rural Livelihood Development Company
RPS	Renewable Energy Portfolio Standards
RWEDP	Regional Wood Energy Development Programme
SADC	Southern Africa Development Conference Cooperation
SDS	Swiss agency for Development and Cooperation
SFA	Sustainable Forest Initiative
SFP	State Forest Permission
SFM	Sustainable Forest Management
SIFMA	Socialized Industrial Forest Management Agreement
SSC	Swedish Space Corporation
SWP	Sustainable Woodfuels Production
TANWAT	Tanganyika Wattle Company
TaTEDO	Tanzania Traditional Energy Development Organization
TCN	The Timber Corporation of Nepal
TLA	Timber License Agreement
TOF	Trees Outside of Forest
TPES	Total Primary Energy Supply
TSI	Timber Stand Improvements
UBET	Unified Bioenergy Terminology
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
URT	United Republic of Tanzania
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VDC	Village Development Committee
V & M	Vallourec and Mannesmannrohren
WECS	Water and Energy Commission Secretariat
WISDOM	Woodfuel Integrated Supply/Demand Overview Mapping
WRI	World Resources Institute

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Summary

The International Energy Agency's (IEA) Key World Energy Statistics published in 2008 show that the World Total Final Consumption for Combustible Renewables and Waste stood at 13.2% in 2006 as compared to 13.2% in 1973. This means that after more than 30 years, the reality that biofuels and bioenergy, including woodfuels and fuelwood will remain to be used in the many years to come. Its consumption may yet persist to be traditional in poverty regions, but modernization efforts are rapidly expanding particularly in more developed countries. This is mainly due to the fact that bioenergy resources are still abundant in many areas, it can be locally sourced as it is indigenous, and if managed properly, these resources are environmentally appropriate and sustainable.

According to FAO, woodfuels consist of all types of biofuels originating directly or indirectly from wood biomass that includes fuelwood, charcoal and black liquor (not included in this study). The growing interest in wood energy is leading to a high demand for woodfuels. There is a general concern that increased woodfuel use may cause additional pressure of already dwindling supply sources leading to additional deforestation and devegetation. As such, standards for sustainable management of different supply sources of fuelwood and charcoal are needed to ensure renewable woodfuel production and uses. However, many aspects influencing the different processes and operation units of the production of woodfuels are not yet properly understood, described and quantified.

FAO and IEA Bioenergy Task 31 have developed a project to evaluate criteria and indicators applicable to woodfuel systems to ensure sustainability. This project considered environmental, economic and social criteria, as well as the legal and institutional framework, which can ensure the sustainable production of woodfuels from forests, trees outside forests and other sources. As part of this project case studies were conducted in five developing countries covering three geographical regions. The case studies of Brazil, Guyana, Nepal, Tanzania and Philippines provide essential information to contribute to the elaboration of principles, criteria and indicators for sustainable woodfuels.

The importance and significance of woodfuel production and consumption all over the world particularly among developing countries is huge. The need for a policy framework that will provide sustainability in production and management can no longer be delayed. But are countries ready to establish one? Are data and information available? Is there political will among governments and its citizens so that despite rapid industrialization, a sustainable woodfuel production will continue to be achieved in the years to come? These are some of the questions that these case studies sought to answer. Each country's case is unique from the other yet similar in the way that woodfuels continue to be a traditional source of energy yet data and policies are wanting. And despite these circumstances, there is much evidence to show that woodfuels particularly charcoal and fuelwood production, consumption, and trade do have tremendous socioeconomic and environmental impact in all these countries.

1. Introduction

Brazil is one of the BRIC (Brazil, Russia, India, China) countries. The 21st century is heralded to be the century of the BRIC countries. Brazil is set to experience one of the fastest economic growth rates in the world. Together with this is the increase in its insatiable demand for energy which, if not coupled with increased energy efficiency efforts or discovery of new sources, would put immense pressure on the energy economy. Home to the Amazon rainforests and numerous other forest covers, wood has figured to be an integral energy source in Brazil since the olden times. Now, there is renewed interest in the Brazilian woodfuel production system and these papers highlight the importance of developing a standardization process of fuelwood and charcoal production to ensure renewability and long-term sustainability. They examine both urban and rural consumption trends, trace the production chain, and select certain industries to showcase the possible promise of fuelwood utilization and the peril of charcoal consumption. By briefly discussing two past certification processes of forest management and chain of custody, these practices are linked to the possible development of criteria and indicators for the woodfuel industry.

Guyana is a tropical country in South America and has a high forest cover of over 75%. Yet because it sits on a landscape with readily available fossil fuels, fuelwood only accounts for 7% of total energy usage which is atypical for a developing country. However, three decades ago, there was a large fuelwood industry in Guyana and today, despite its low share of total energy, fuelwood still figures to be a significant localized source of energy and income. On the other hand, charcoal production in Guyana is robust as it produces to fulfil both local and export demand. Charcoal is mostly from the secondary forests, and made using the adoption of the pit tumulus and portable kiln methods. Farmers, loggers and professional producers constitute the suppliers of charcoal, and outlining the supply sources and analysis of particular units in the production processes have resulted in several recommendations put forth by the researcher for the Guyana woodfuel industry.

Nepal is land-locked and despite being nestled between economic powerhouses India and China, is still one of the least developed countries in Asia. In an effort to improve Nepali standard of living, bettering access to clean and affordable energy is part and parcel of this quest. Traditional biomass fuels, including fuelwood and charcoal, comprise the bulk of national energy consumption and the slow national development means that this trend will persist in the near future. Nevertheless, energy policies and institutions have so far failed to provide due attention to such integral part of the national energy economy. This paper calls for a paradigm shift of national energy policy by instituting criteria and indicators of sustainable woodfuel production systems. It builds upon the momentum of the development of specific criteria and indicators for community forestry and forest management developed under the auspices of the ITTO. The C&I should incorporate the sustainable management of both the forest source and the woodfuel product in order to truly ensure long-term systemic sustainability. Probing the prevailing woodfuel production system in Nepal provides a clearer picture of the challenges and opportunities for policy makers to enact regulations in select areas which will be outlined later on.

Tanzania derives approximately 92% of its energy from fuelwood and charcoal, this group of woodfuels is an integral part of the national development agenda and the daily lives of citizens. More recent concerns on global warming have increased the scrutiny on the environmental sustainability of resource management practices. In

Tanzania, the rapid deforestation has been attributed to unsustainable fuelwood consumption particularly for agriculture and other small industries with charcoal production being charged for the degradation of woodlands. An analysis of the fuelwood production reveals the competitive and cooperative relationship of fuelwood with select industries. Furthermore, charcoal production has become one of the main rural economic activities due to the little expertise and capital required. Because of the presence of numerous small-scale producers, the large informal economy makes it hard to obtain official records on the producers and their volumes as evident in how 75% of the charcoal supply in Tanzania's largest city remains undocumented. The certification process that will be presented in the later section of the paper will incorporate such realities in the formulation of C & I for sustainable woodfuel production.

The Philippines being the second largest archipelago in the world that stretches over 7,107 islands, the Philippines is naturally endowed with a wealth of flora and fauna. Its lush forests provide various types of natural resources, among these are woodfuels. Nonetheless, woodfuels are also sourced from non-forest areas and areas that are "in-betweens." Woodfuels have figured to be one of the major sources of energy for Philippine households and industries, yet are also in the centre of debates regarding causes of deforestation and environmental degradation. Cognizant of the increasing importance of woodfuel as an energy source and the controversies surrounding them, this paper documents the various chains of the production system of woodfuels so as to develop a broader understanding of the issues and challenges in developing a system for sustainable management. Using anecdotal evidence from various parts of the archipelago and the case study of Cebu, the present woodfuel production system is mapped out with an analysis of pertinent issues that relate to production chain certification.

COUNTRY SUMMARIES

Brazil

In a world where the search for alternative fuels is the order of the day, Brazil is at the forefront of these discussions. Apart from being the second most forested country in the world, it also has huge potential in producing ethanol. Hence, this external and internal overemphasis on the development of alternative fuels has left energy policies for traditional sources wanting. Thirteen percent of the country's energy is derived from woodfuels, with the charcoal and fuelwood sectors employing over 235,000 people.

As such, the authors Noguiera, Coelho and Uhlig discuss the historical and contemporary narratives of charcoal and fuelwood production in Brazil in the hope of putting forth policy recommendations later on. Their discussions show that the concern for fuelwood production sustainability lies in the ability of select industries to implement good management practices. As households generally obtain their supplies from non-forest areas, they do not accelerate deforestation and desertification. Moreover, the pulp and paper industry may serve as a model of a fuelwood production and consumption sustainability program due to its present self-sufficiency and energy independence.

On the other hand, the major concern for charcoal is its concentrated production in dense pig-iron industrial areas which has accelerated the denudation of forests. To address this, the researchers sketch out several attempted solutions including improved furnace technology and reforestation. In spite of the absence of a set of guidelines for sustainable forest management and in particular the non-existence of a set of Criteria and Indicators for sustainable woodfuels production, the government still played a significant role in affecting the market conditions of fuelwood due to the subsidization program and policies it instituted up until 2001. Hence, these papers provide the picture of the woodfuel sector including its political underpinnings in the hope of achieving a set of standards to ensure renewability and sustainability of the woodfuel system.

Guyana

There is a need for woodfuel baseline studies so that policy formulation particularly Criteria and Indicators for sustainable woodfuel production can be undertaken. According to the author, G. C. Clarke, the South American nation of Guyana is one of the few countries that exports charcoal to neighbouring areas. With its ready supply of fossil fuels, the country is neither a major supplier nor consumer of firewood. Nonetheless, this paper still asserts the importance of the production, transport, sale and use of firewood in Guyana as it contributes to the local energy and income. Moreover, the recent reports of increasing proportion of charcoal produced for exports may be a tell-tale sign of a new engine of growth. By documenting the firewood and charcoal production process, the researcher was able to show the relative small size of both industries judging from the licenses that were issued and the royalties that were collected. Despite firewood being officially recognized as a forest produce, the only regulations that persist are the required licenses and removal permits. As such, there is a growing concern of the sustainability of current woodfuel production system. In fact, the intensive exploitation of the *wallaba* forests for woodfuel extraction has been blamed for the severe degradation of this forest type. Hence, the researcher calls for more in-depth studies in quantifying the environmental repercussions of present practices and delve into the precise location of raw materials and obtain more information on socio-economic impacts.

Nepal

The set of Criteria and Indicators for sustainable woodfuel production in Nepal was culled from various documents particularly that of International Tropical Timber Organization (ITTO). The author, Tara N. Bhattarai, did a comprehensive review of the wood energy systems in Nepal in this case study. Accordingly, Nepal, being the youngest republic in the world, is the poorest, least developed country in South Asia. With it being in the early stages of development, the country still relies heavily on traditional sources of energy like woodfuels and biomass. Thus, woodfuels serve both as a revenue source and as an energy source. Nonetheless, despite statistics pointing to the Nepali economy being heavily reliant on traditional energy sources in the near future, present energy policies mainly focus on commercial energy sources. Hence, this paper stresses the need to establish a set of criteria and indicators for woodfuel production sustainability so as to address environmental and energy-security concerns. It charts and analyzes present wood energy systems and recognizes the inherent qualities of woodfuels derived from public and private lands. Because of the differences in land size, presence/absence of zoning regulations, and each type of forest ownership's long-term viability, two separate monitoring systems are needed.

The lack of information regarding the total volume and value of woodfuels from private lands traded in the market only allows the establishment of a framework based on product tracking and the transformation process, without really identifying the source. On the other hand, since woodfuels produced by government lands are usually by-products and residues of the implementation of forest management plans, a multi-pronged approach of certifying the product as well as the source and process is possible, and highly recommended. In this way, economic, ecological and social concerns can be addressed. Nepal has had two previous forest certification systems with different goals and criteria; the new, suggested system aims to incorporate these two different goals of promoting international trade and ensuring environmental sustainability. The author recognizes that only with the concurrent certifications of the forests and forest products can there be a sustainable production of woodfuels – both economically and environmentally.

Philippines

By tracing the history and evolution of woodfuel production and consumption in the Philippines, the paper convinces readers of the importance of woodfuels (fuelwood and charcoal in particular) as an energy source for both households and select industries. Yet, as far as energy management and policy is concerned, it has often not been given due importance or in some instances even neglected. E. M. Remedio and T. G. Bensel's research shows that the Philippines have the sufficient amount of woodfuel resources to meet the immediate needs of the future. Claims regarding woodfuel demand outstripping supply thereby threatening our energy security are unfounded; instead, the challenge for the Philippines is to develop a framework to ensure a more sustainable harvesting of woodfuel resources in the country. With years of accomplished research coupled with her international organizational experience, the author is in a unique position to provide a critical analysis of the Philippine woodfuel production system. Her work provides an upbeat, optimistic view regarding the need to develop comprehensive legal, institutional and policy frameworks for a more sustainable woodfuel production system. Examining the criteria and indicators for sustainable forest management (SFM) adopted by the Department of Environment and Natural Resources based on the model created by International Tropical Timber Organization (ITTO), the paper outlines a number of recommendations for the development of a set of Criteria and Indicators specific to the Philippine Woodfuel Production. It calls for the synergizing of the various agencies that presently deal with woodfuels in order to create and formalize an institution whose main responsibility it is to oversee woodfuel production in the Philippines. At the end of the day, this research hopes to see the adoption of such recommendations so as to tackle this important challenge facing the Philippines today, and maybe even serve as a model for the development of sustainable woodfuel production systems in other developing countries.

Tanzania

The premise of this paper, as set forth by authors R. E. Malimbwi and E. Zahabu, is that the current woodfuel production practices are not sustainable and they are primarily responsible for tropical deforestation, hence there is a need to develop a certification procedure that emphasizes sustainability. Moreover, the importance of improving the current fuelwood production system in Tanzania stretches far beyond the ensuring of environmental sustainability. Understanding Tanzania's rural context where fuelwood gathering is done mainly by women and children, improving the system would mean freeing up the women for other employment opportunities and the children for schooling opportunities. The opportunity costs associated with fuelwood gathering are too huge to be ignored; hence, this research proposes a system of certification of forests and woodfuels that also keeps these issues in mind when formulating criteria and indicators for sustainable woodfuel production. In the second half of the paper, limitations of an effective certification system in Tanzania are discussed and possible remedies are recommended.

CONCLUSIONS AND RECOMMENDATIONS

The five case studies showcase the fact that the status of forestry and woodfuels - be it fuelwood or charcoal – are all case specific and site specific. Some countries have drafted their Criteria and Indicators for sustainable woodfuels production; others are mid-way of doing so, while others, have not prioritized such task. Lack of political will, lack of disaggregated data, lack of technical expertise, social and cultural factors and even environmental implications have all coloured the case studies of the countries under study: Brazil, Guyana, Nepal, Tanzania, and the Philippines. Nonetheless, all agree that in order to sustain current production and consumption of woodfuels, policy is high on the list of must do. As such, the individual case studies are significant documentation efforts towards the promotion and implementation of sustainable woodfuel production in the years to come. FAO together with partners and collaborating agencies such as IEA need to strengthen and reinforce the commitment to pursue C and I work. Resources will have to be allotted and technical expertise need to be developed to ensure the success of such endeavour in the nearest future. Below are the case specific conclusion and recommendations for the five countries represented:

Brazil

Despite the lush forested areas in Brazil, the scarcity of wood still exists and there is no bioenergy policy that deals specifically with wood energy sources. As such, the paper outlines the regulatory, economic and fiscal recommendations for the sustainable production of Brazilian woodfuels.

There has to be long-term targets and timelines to increase the supply and lower the cost of the planted wood which are used directly as energy source or converted to other forms such as charcoal. To aid the collection of supply and demand statistics, there needs to be a national wood energy information system that gathers and publishes the relevant data. A breakdown into regional statistics can further enhance the predictability of long-term market conditions and places producers, consumers and policy-makers in better positions to respond.

Furthermore, the establishment of standards and practices on wood energy systems reinforces the direction of certification. Such principles should help increase the forested area in Brazil and develop forest management techniques in line with modern ecological strategies. An adoption of forest zoning with sustainable management in select areas can help the continuity of wood supply to charcoal producers as this protects some forested areas from being subsumed by agricultural expansion.

Another step that could be taken to move towards a more sustainable woodfuel production in Brazil is to promote the research and development of improved technology. Universities and other research institutions can delve into the respective situations of forests and woodlands in order to pinpoint the stressed areas.

To support such steps, strict enforcement of set regulations on the transport and use woodfuels is necessary. Broader surveillance against illegal deforestation and corruption can strengthen enforcement efforts. Better equipped personnel and a stronger legal framework is required to underpin such stringent implementation, although the lack of local capacity building and adequate funds may be constraints.

To sum it up, this study highlights that residential woodfuel usage is not relevant and some industrial sectors are even energy self-sufficient. Nonetheless, the presence of select industries whose efforts seriously undermine the sustainability of woodfuel production calls for the proactive approach towards policy-making. A holistic energy policy needs to recognize the pervading importance of woodfuels in households and industries.

Guyana

The enduring importance of woodfuels in Guyana dictates the need to institute sustainable management practices of these resources. Although firewood only comprises 3.5% of the total timber produced in 2006, a closer examination of the socio-economic circumstances of the people in Guyana drives home its continuing importance to the country's economy. Moreover, charcoal production serves as a means of livelihood for a lot of local community members. Reports of increased Guyana charcoal shipped overseas highlight the sector's long-term potential for expansion, generating jobs and alleviating the pressure exerted by the energy demand of a burgeoning economy. Efforts to encourage this expansion are laudable, yet this should be kept in check with sustainability standards in mind.

Even though environmental repercussions are still difficult to quantify, there is a growing consensus among experts that the charcoal and firewood sub-sectors have contributed to the degradation of certain forest types. As these forests are relatively fragile and easily accessible, the actions of the industry produce quite significant environmental repercussions.

To tackle such environmental sustainability challenges, there needs to be more conscious efforts in pinpointing the exact location of woodfuel sources and quantifying the amount of trees cut for private, domestic purposes. Despite the fact that there were only nine firewood dealers in 2006, the fact that most cutting was done by smaller, independent cutting units made monitoring the dealers' actions not that effective. Moreover, reserve areas may be established within white sand forests in order to preserve the unique ecosystem and to safeguard water supply. The rehabilitation of forest cover and development of a forest fire protection plan are also recommended actions for forest management officials.

In developing a comprehensive woodfuel energy policy, the present size and attributes of wood resources should be coupled with the long-term vision of how the sector would look like. Such a policy framework can serve as groundwork for a national management plan for woodfuel production, which includes criteria and indicators for sustainable woodfuel production and protocols for proper monitoring and feedback.

Nepal

In conclusion, there needs to be a system put in place that certifies the overall management of the forest. This means that there has to be simultaneous certification of the source and the process to ensure the sustainable production of woodfuels. The set national standards can help ensure the long-term sustainable supply of important firewood and charcoal for trade. Since Nepal has woodfuels produced from public and private lands, the underlying differences in attributes between two sources necessitate two separate monitoring systems.

With regards to the certification of sustainable woodfuel production from public lands and their trade, it is possible to undertake it at the Forest Management Unit (FMU) levels. The principles, criteria and indicators identified for the certification of community forest management can serve as a guide for the development of similar principles, criteria and indicators for the certification of sustainable woodfuel production for trade. The pursuit of SFM is a long-process, yet the productive function of forests cannot be stopped indefinitely while SFM is being developed. Instead, an approach that could be taken is to first identify the standards that the country would adopt in the SFM certification and then establish C & I for its monitoring. Such C & I should include common elements of the C & I outlined by groups at the regional and global level. Furthermore, the huge amount of financial and technical resources used in its development would require outside assistance. The development of a certification system admittedly is a long process; hence a plausible short-term approach would be to ensure the sustainable production of certain forest products like fuelwood and charcoal harvested from public lands.

On the other hand, private forest management is more complex. The recommendations put forth by the present study is only directed to government-managed forests and based on the premise that forest certification is only a step towards initiating a SFM certification in Nepal. Moreover, they also do not apply to the certification of sustainable production of indirect woodfuels and those recovered from all sources, and charcoal. Such processes need a separate "chain of custody" monitoring system – one where the transformation and transportation of the products are tracked. In the process of developing the abovementioned standards, particular attention should be given to ensure illegally harvested products do not get mixed with the regulated ones. This product tracking system coupled with the principles, criteria and indicators for the sustainable production of direct woodfuel from government lands support the ongoing efforts of promoting SFM in Nepal.

On a macro-scale, it is possible to engage the services of an accredited international certifier for the initiation of forest certification albeit this is oftentimes expensive. As an alternative to this expensive approach, the country has established the Nepal Foresters' Association (NFA), a national working group comprising important stakeholders to come up with a flexible set of national certification standards. Tasked to devise and test an economical and practical forest certification system that matches FSC standards, it tapped on the UNDP/GEF Small Grant Program to further this initiative. This development of a national authority of forest certification allows the organizing of national initiatives while making good of commitments made by Nepal to regional and international agencies. With a national certifying infrastructure in place, the NFA can then apply for accreditation from an international certifying agency.

This study recommends that the NFA consider the proposed principles, criteria and indicators both for the certification of government managed national forests and forest plantations and CF, and for the certification of private forests, TOF and indirect woodfuels outlined in this study.

Philippines

Woodfuels are still a very important energy source in the Philippines. A number of industries and majority of households rely on fuelwood and charcoal for both primary and secondary energy sources. Users are predominantly low-income households, where fuelwood and charcoal trading also serve as revenue streams for urban and rural households alike. In rural areas, about 70% of households gather fuelwood for free from the surrounding, non-forest areas. Hence, it is because of fuelwood's free nature that efforts by the DENR to introduce more efficient cookstoves may be resisted by the locals.

Despite the fact that fuelwood and charcoal figure to be a major alternative to imported energy, the Philippine energy plans fail to factor in the integral role of woodfuels in the country's energy economy. Guidelines linking woodfuel requirements to the management and development of energy resources are also absent. Moreover, there is no specific institution that is directly responsible for overseeing and coordinating woodfuel related programs and research. This leads to the lack of information regarding both the aggregate and localized supply and demand of woodfuels. Such a scenario leads to some resource-rich provinces having underutilized fuelwood resources, while other Category I, II, III provinces may encounter shortages in the short-term. Aside from the absence of a central coordinating agency, the preference for fuelwood over other biomass resources can also result to over-exploitation of primary fuelwood resources. Consequently, many rural areas possess surplus and underutilized secondary biomass resources.

It is also important to note the limitations of the trade of woodfuel resources. Aggregate demand and supply may balance out, yet the spatial distribution of supply and demand and ensuing transportation costs may limit this aggregate model. As such, a spatial variation to woodfuel sector policies must be practiced to recognize such location-specific characteristics.

A closer look at biomass conversion technologies reveals that there are no constraints to their availability. However, the currently used technologies are inefficient as there is no institution spearheading the research efforts of such cost-sensitive technologies. Albeit there are a number of improved technologies for charcoal production, the majority of charcoal is still produced using old, inefficient methods in underground pits or above ground mounds. Such inefficient production and use of charcoal as a biomass fuel may compromise the resource sustainability of fuelwood, unless conversion technologies are further improved. This harks back to the need to re-evaluate present charcoal production policies and programs, and further underscores the need to establish a formal institution whose main responsibility is to oversee the woodfuel sector.

Presently, the Philippine Forestry Sector is working out guidelines and schemes to implement the C & I system for Forest Certification. Such a system applies to the forest and forest products, yet the majority of woodfuels are produced in non-forest, small farm management units. As such another set of C & I is needed to certify woodfuels from agricultural and non-forest lands.

Several indicators still continue to fall short of compliance with the present Philippine C & I system as they only apply to the national level but not at the forest management unit levels. Policies, laws and regulations pertaining to the governance of forest management exist and are implemented only on the national level. Moreover, institutions that oversee sustainable forest management are poorly structured and staffed at the FMU levels. At the local level, there is also no process of identifying and protecting endangered flora and fauna, which also means the absence of biological corridors and stepping stones that connect protected areas. The percentage of total forest area devoted for the protection of soil and water at the FMU levels continues to fall short of the compliance of the Philippine C & I System. Furthermore, the indicator pertaining to value of the national forestry sector to the GDP is still under consideration.

Tanzania

The need to develop a certification procedure for woodfuel production that emphasizes sustainability has never been stronger. Deforestation has largely been attributed to the unsustainable woodfuel production techniques currently adopted, so the paper puts forth several recommendations that address the current limitations of the system.

An important research area would be on the development of standards for woodfuel forest management as the dearth of management plans leads to the lack of reliable data and forest inventory. With more actionable data accompanying efforts to engage forest practitioners, these practitioners are in a better position to evaluate and monitor the management practices.

Important institutional capabilities need to be developed, and wherever present, strengthened. The cost of the certification process balloons due to the lack of local certifying agencies as the government has to tap on services of expatriates. Furthermore, the weak enforcement of land tenure and user rights lead to occasional disputes which hamper the certification of the land. Certification is admittedly still a new concept in Tanzania; the only national project that has certification as a prerequisite has not achieved its goal to date. The complexity of the certification process further reinforces the need to develop formal institutions to accelerate the process.

As a final step to ensure long-term sustainability, a market for certified woodfuels needs to be developed. The current practice of extracting woodfuels from unmanaged forests makes it possible to get them for free. As such, the more expensive certified wood and charcoal may not be a viable alternative from the users' point of view. Hence, research on more efficient woodfuel production and distribution techniques can help certified woodfuels become a more viable alternative.

2. Sustainable fuelwood production in Brazil

Luiz Augusto Horta Nogueira, Universidade Federal de Itajubá; Suani Teixeira Coelho, CENBIO & Alexandre Uhlig, Instituto Acende Brasil

INTRODUCTION

Since colonial times, wood has played an important role as energy source in Brazil. Even with industrialization and introduction of fossil fuels, fuelwood from native and planted forests remains a relevant source of heat in Brazilian industries and households, representing about 13% of total energy demand. Wood is abundant and an important resource in the economy of Brazil. The Brazilian native forests cover about 416 million hectares and accounts for 31.1% of world total woodlands. On the other hand, the afforested area is estimated to be 4.1 million hectares and the ranks fifth in the world. The afforested area is known to increase approximately 250 thousand hectares per year. Forestry is conducive to Brazil due to the following factors: (1) Favorable climate; (2) large agricultural land, and; (3) Presence of good forestry technology. In fact, 4.5% (or US$ 28 billion) of GDP comes from forestry. Despite all these, forest resources are at present becoming scarce.

At present, there seems to be a decline in forest resource production. For instance, in 1990, round wood production recorded 308.2 million cubic meters whereby 26.8% of it was contributed by planted forests. However, in 2004, production decreased to only 218.2 million cubic meters, with 62.6% coming from planted forests. The trend over the past 15 years showed that total round wood production and production from native forest has markedly declined at annual rates of 2.36% and 7.27% respectively. According to Bacha et al., (2006), even with a growth rate of 3.39%, planted forests will not be able to cope with wood demand for industrial and energy needs. Apparently, there may be a current difficulty to supply wood demand in Brazil as shown by the following indicators: (1) Reduced wood production for export; (2) Higher prices, and; (3) Government's urgent need to promote reforestation.

The supply and demand imbalances is becoming acute and has resulted in heightened environmental concerns and doubts about the sustainability of intensive use of biofuels. In some areas fuelwood use contribute to high rates of deforestation e.g. industrial use of fuelwood from native forests. Forestation activities on the other hand, have decreased over the last few years thereby reducing wood availability for industry and energy. Related to energy, there are situations that deserve urgent attention to reduce the depletion of natural forest resources. For example, the pressures on savannah cover, *caatinga*, in the Northeast Region, to supply fuelwood to gypsum kilns, or the growing difficulty for the pig iron industry to obtain charcoal. According to IBGE, 2006, the commercial fuelwood sales in Brazil amounted to 81.0 million cubic meters in 2005 and generated USD 1.3 billion[*] in annual sales. These are fuelwood from both native forests and forestry plantation.

There is no official estimate of the actual number of jobs provided by fuelwood production. Developing an estimate of the actual number of jobs requires some assumptions about how much the average of fuelwood produced per worker is. This is done using the data from pulp and paper sector, where on the average, workers produced 1 100 stereo cubic meters of fuelwood per capita per year (BRACELPA, 2007). For fuelwood from native forest, the productivity is about half compared to

[*] The exchange rate in 12 January 2007 was BRL 2.14 to a US dollar.

those in forestry plantation e.g. 550 stereo cubic meters of fuelwood per worker per year. Thus, fuelwood production provides employment to approximately 115 thousand people in Brazil in 2005.

Following this introduction, a brief review of demand and supply of fuelwood is presented. These are obtained from official sources. Although there are many indications of inconsistencies in fuelwood data even in the National Energy Balance, it is worthwhile to recognize that efforts have been done towards improving this information. The current methodology for fuelwood demand evaluation and the improvements in the study are shown. Finally, a set of policy guidelines are recommended in order to increase fuelwood availability in the context of sound environmental management conditions.

FUELWOOD SUPPLY AND DEMAND

Energy use has been growing rapidly in Brazil. Total energy consumption nearly doubled between 1975 and 2000. Energy consumption per capita increased by 60% and energy consumption per unit of Gross Domestic Product (GDP) increased by 22% (GELLER *et al.,* 2004). Rapid industrialization, high growth in some energy-intensive industries i.e. aluminium and steel production, and the increasing residential and commercial energy services are among the main causes of increased energy use and energy intensity (TOLMASQUIM *et al.,* 1998). Total primary energy supply (TPES) grew in average around 2.5% per year in the last 20 years. This number is slightly higher than the annual economic growth rate of 2.1% during this period.

Energy policy in Brazil in the last three decades attempted to reduce the country's dependence on foreign energy supplies and stimulate the development of domestic energy sources, mainly from hydrocarbons. Also during this period natural gas and hydroelectricity production increased steadily over time; oil consumption decreased in the first half of the 1980s, but since the oil counter shock in 1986, it has been recovering its market share. The demand for coal increased due to the metallurgical sector. Biomass consumption increased in the transport and industrial sectors.Biomass for transport is very important in Brazil due to ethanol from sugar cane, which production corresponds to approximately 300 thousands barrels of oil equivalent per day, but it is out of scope of the current study. Biomass use in the residential sector decreased due to fuelwood substitution. In the next paragraphs the current status of the fuelwood use and an analysis of the sustainability of the supply are presented.

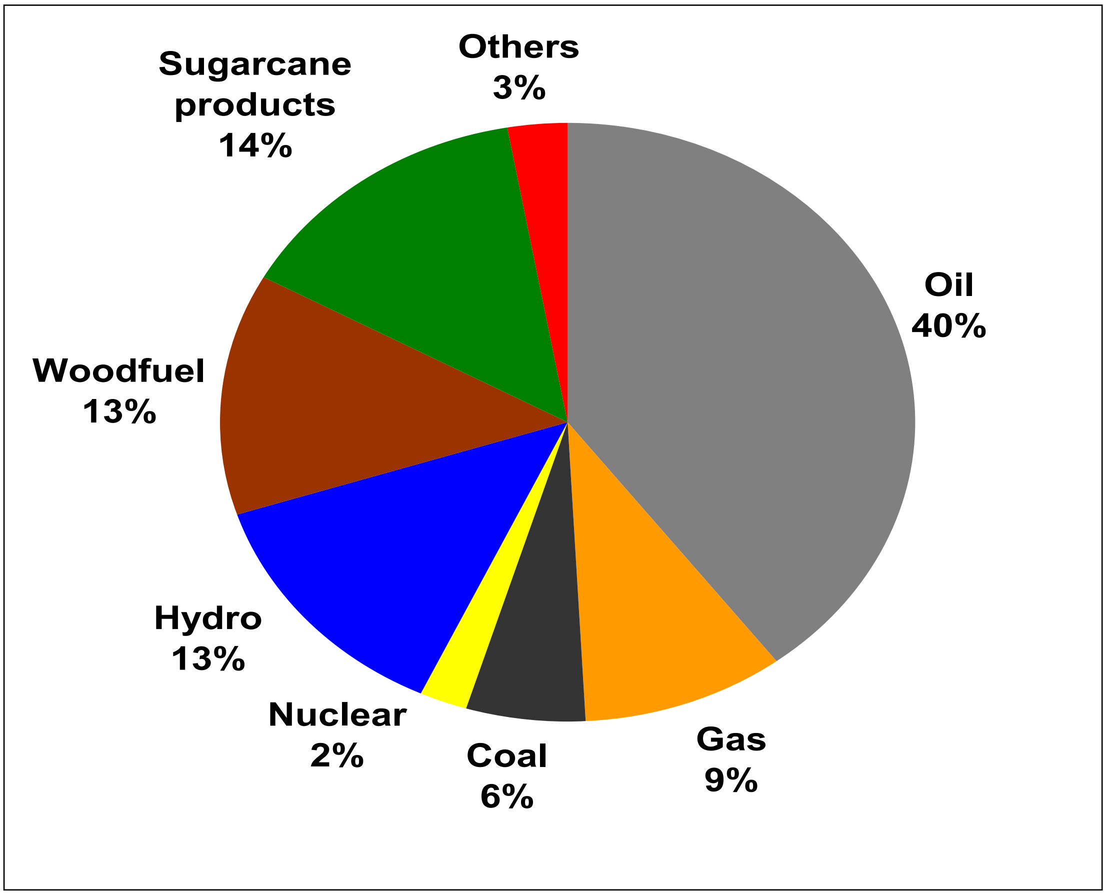
According to the Ministry of Mines and Energy, 13% or 28.4Mtoe (2005) of TPES is provided by woodfuels (Brasil, 2006). This is almost at the same level with the rate supplied by hydropower generation. Despite the importance of woodfuels in the energy mix, the demand for woodfuels steadily decreased from 1970 to 2000. In 2004 however, the trend reversed as woodfuel demand rose to the level similar to that during the 1980's (see Figure 2).

In the last ten years, the fuelwood demand has remained almost constant in residential, industry and agriculture sectors. The changes in fuelwood consumption happened basically in the transformation sector, where fuelwood is converted into charcoal. This product is directly related with iron and steel industry and represented 43.3% of total fuelwood consumption, in 2005. Due to its relevance, charcoal issues will be analyzed in more detail in a separated paper.

Regarding residential sector, it is important to notice that the use of woodfuels in Brazil has changed notably over the past several decades. Fuelwood use for cooking and heating fell from 19.0 Mtoe in 1970 to 8.2 Mtoe in 2005, though there are some indications that high oil prices have recently reversed this trend.

On the whole, the demand for fuelwood in the residential, industrial, and agricultural sectors has remained to be constant. A few changes have been observed however. Foremost is the increased demand for charcoal in 2005 which accounted for 43.3.% of fuelwood consumption (fuelwood is converted into charcoal). Charcoal is used in the iron and steel industries. Likewise, in the residential sector, there is a dramatic decline in the demand for fuelwood for cooking and heating as the statistics fell from 19 Mtoe in 1970 to only 8.2Mtoe in 2005. Households have been observed to switch to the use of LPG. The recent increase in oil prices however may have reversed this trend.

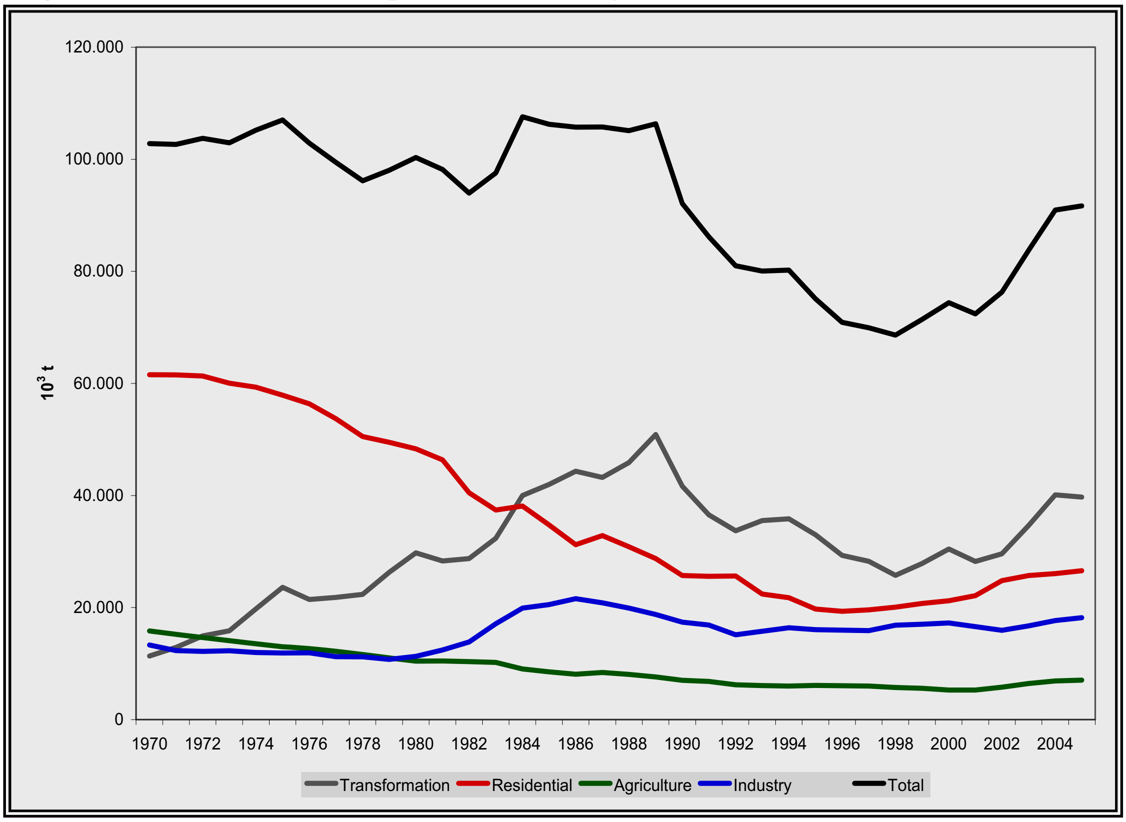
Figure 1. Total Primary Energy Supply in Brazil in 2005



Source: BRASIL, 2006.

In the 1970's, almost 60% of fuelwood demand was used for cooking and heating in the residential sector. In 2005, fuelwood continued to be an important source of energy for preparing food. Many poor households still relied predominantly on fuelwood to meet their cooking and heating needs, despite uncertainties. Among which were the lack of information and the effect of prices of substitutes, especially electricity and liquefied petroleum gas (LPG).

Figure 2. Fuelwood consumption in Brazil by sector



Source: BRASIL, 2005.

The Brazilian experience with LPG

In Brazil, 98% of households, including 93% of rural households, have access to liquefied petroleum gas LPG, a situation that can be mainly attributed to government policy that has promoted the development of an LPG delivery infrastructure in all regions, including rural zones and subsidies to LPG users (LUCON *et al.,* 2004; JANNUZZI; SANGA, 2004). Until the late 1990's, the rise in LPG use was accompanied by a sharp decline in residential wood consumption (Figure 2).

During the period 1973-2001, retail LPG prices were set at the same level in all regions and the average level of the subsidy amounted to 18% of the retail price. In May 2001, end user prices were liberalized, as part of a process of deregulating the petroleum sector. At the same time, the government introduced an *Auxílio-Gas* ("gas assistance") programme to enable qualifying low-income households to purchase LPG. Qualifying families were those with incomes less than half the minimum wage (an average daily per-capita income of $0.34 a day in 2003).

The total programme cost in 2002 was about half that of price subsidization. This program now forms part of the *Bolsa Familia*, by far the largest conditional cash transfer program in the developing world (Managing for Development Results, 2006). Recent LPG price increases, however, appear to have led to a reversal of the trend towards lower residential biomass consumption (Figure 2).

The energy required for cooking represents an important cost for low income people. According to the last official survey on household expenses (IBGE, 2006a), for the lower income group or families receiving up to two minimum wages monthly (14% of Brazilian population), the energy required to prepare food means USD 6.77 every month, approximately the same amount of money used for medicines.

Most woodfuel information comes from the Ministry of Mines and Energy (Brasil, 2006). Despite this limitation, a recent trend has been noticed. There is now a rise in fuelwood consumption per capita as many poor households switched back to its use due to price increases in LPG. In fact, some poor communities in Brazil are now returning to use their old, forgotten inefficient wood stoves.

According to IEA (2006), household fuelwood use in Brazil accounts for 3.7% of TPE. In the rural areas, approximately 13% of the population or 23 million people rely on fuelwood. It is also possible that these figures are in fact lower inasmuch as there are other considerations: Stove efficiency, population, cooking practices, among others. Table 1 reflects multiple fuel use among many of the households.

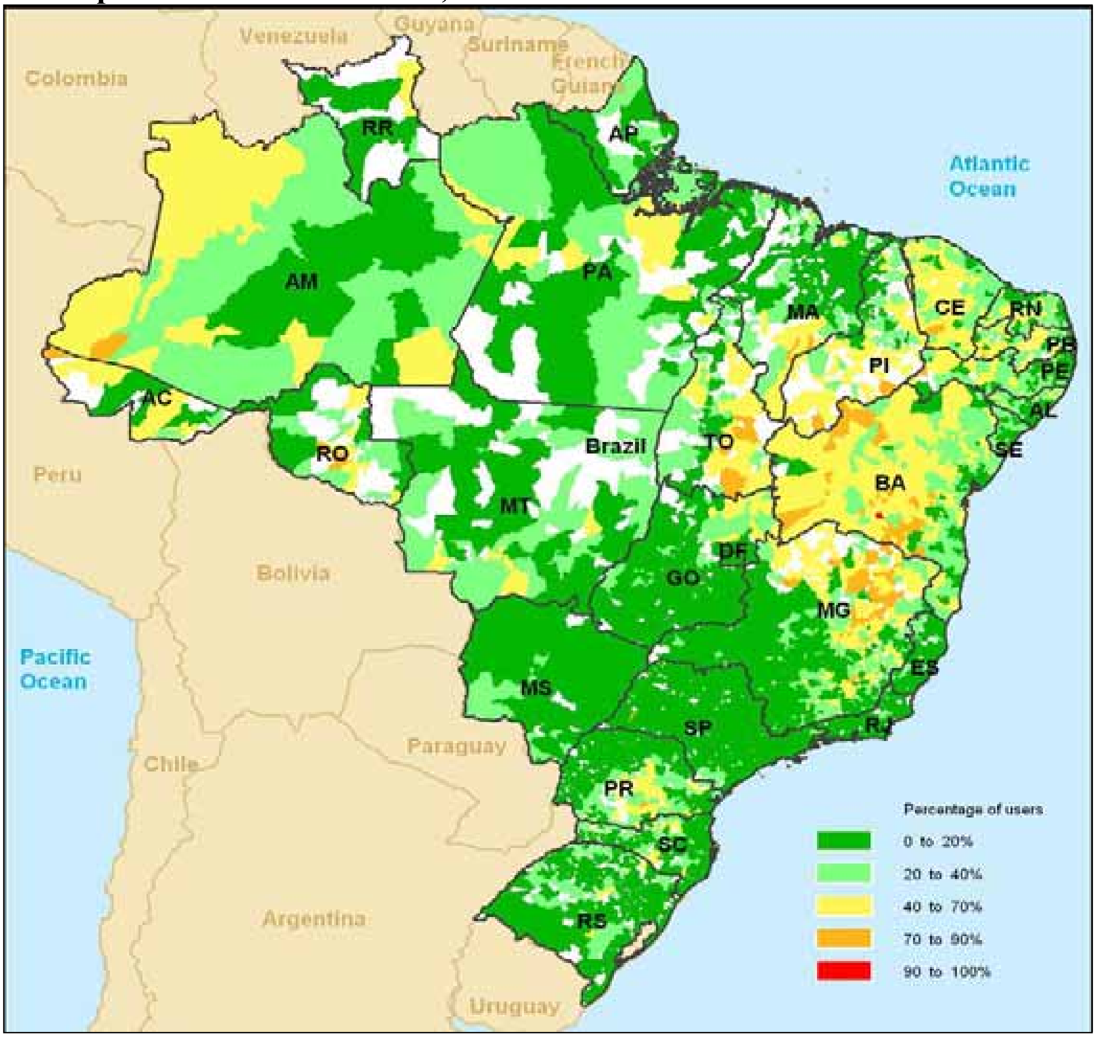
The exclusive fuelwood consumers are concentrated in the poorest region of the country: the Brazilian semi-arid region, north of Minas Gerais State, interior of the States of Bahia, Pernambuco, Ceará, Piauí and Maranhão (Figure 3).

Table 1. Household consumption by fuel and situation in Brazil in 2003

Fuel	Urban	Rural	Total
Only LPG	31,916,473	2,480,533	34,397,006
LPG and fuelwood	3,007,274	4,096,489	7,103,763
Only fuelwood	462,382	1,312,046	1,774,428
LPG and charcoal	4,248,244	874,777	5,123,021
Fuelwood and charcoal	89,244	270,041	359,285
Only charcoal	323,916	311,889	635,805
LPG, fuelwood and charcoal	387,338	442,242	829,580
Total	**40,434,871**	**9,788,017**	**50,222,888**

Source: IBGE, 2004d

Figure 3. Distribution of exclusive fuelwood user in residential sector at municipal district level in Brazil, 1991

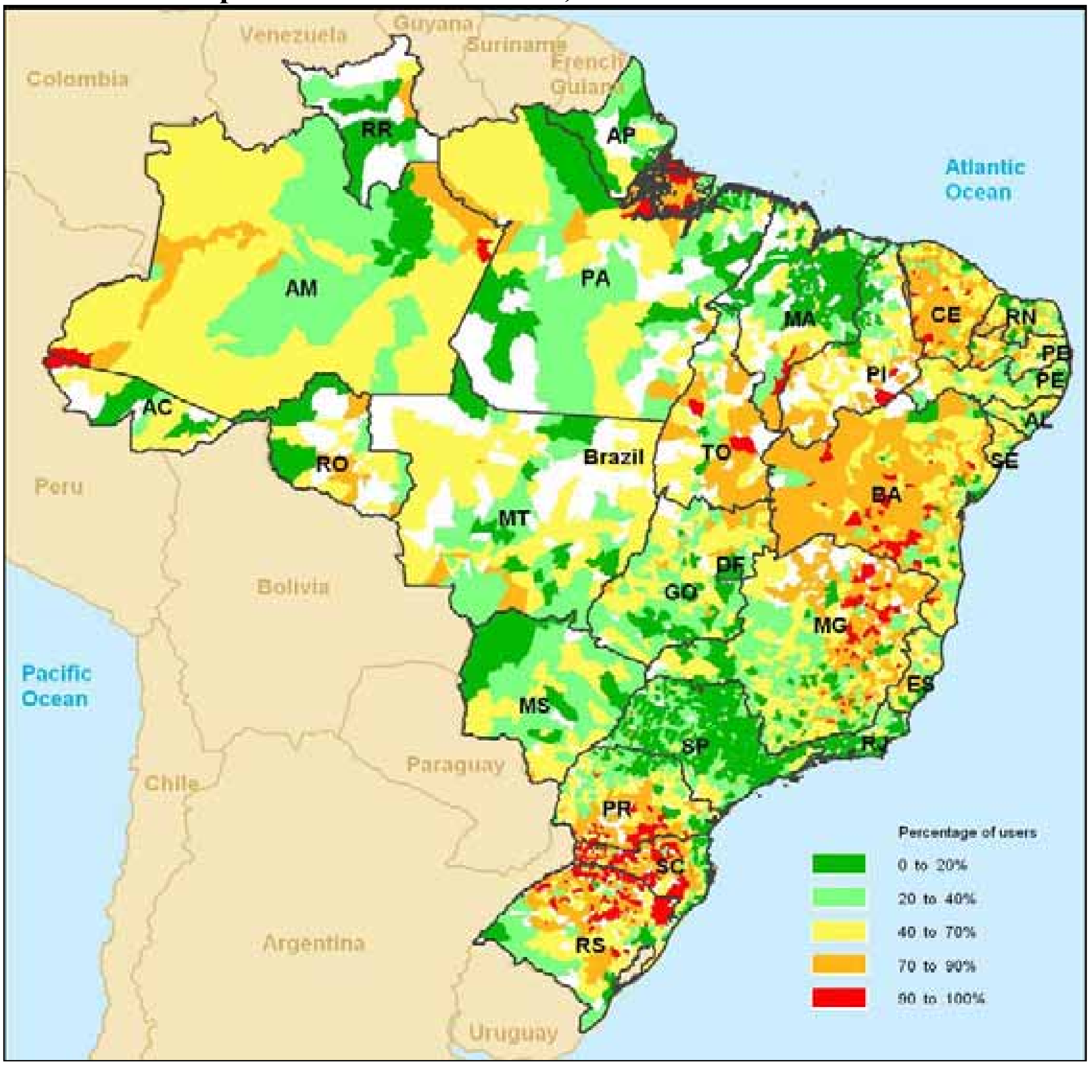


Source: Prepared by UHLIG, A. from IBGE, 2004c.

The scenario however changes when one considers the distribution of households using multiple fuels e.g. fuelwood and LPG. The pattern changes as it now appears that the whole country uses fuelwood (supplemented with other fuels i.e. LPG). Only the more developed states of Sao Paulo, Rio de Janeiro and Distrito Federal do not show fuelwood consumption (Figure 4). Likewise, fuelwood consumption is not significant in the Maranhao State due to a greater reliance on charcoal as this is largely available among pig iron producing areas in this region.

Due to the spatial distribution of industries, there is not much information about fuelwood consumption in the industrial and agricultural sectors. These are areas where detailed studies in fuelwood are much needed as compare to the residential sector where some data already exists. One can only surmise that the fuelwood consumption exists in nearby areas where fuelwood is produced or originates. The Brazilian Pulp and Paper Association (Bracelpa, 2007) for instance, denotes the presence of wood transported within 500 km radius.

Figure 4. Distribution of fuelwood and LPG and fuelwood user in residential sector at municipal district level in Brazil, 1991

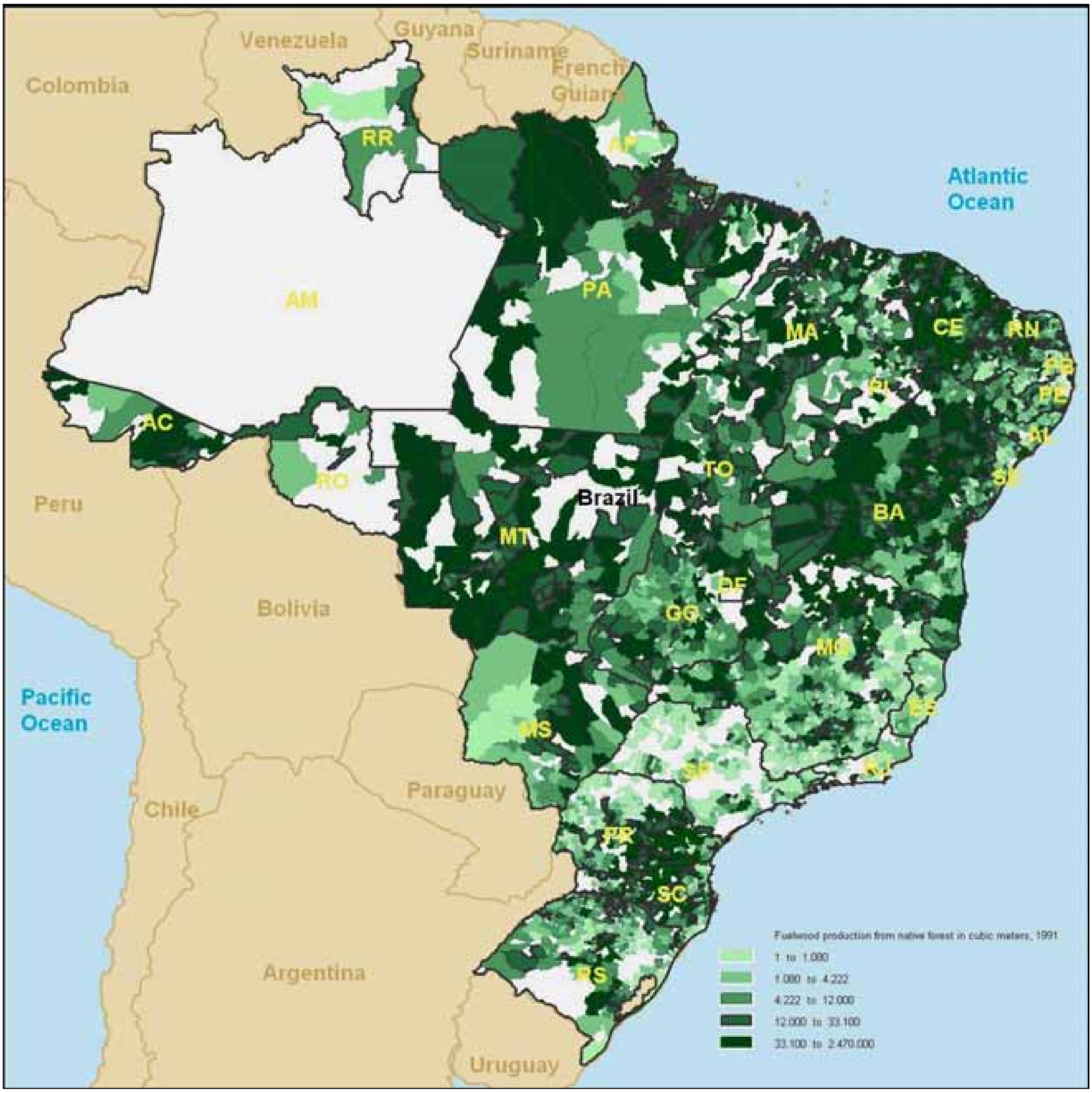


Source: Prepared by UHLIG, A. from IBGE, 2004c.

It is a fact however that fuelwood has many uses in the agricultural sector: Drying agricultural products, preparation and production of animal meals, and in the ancillary agro-industries such as cassava flour manufacturing, sugar cane processing, pottery making, and lime kiln preparations, among others. Official figures do recognize that 7 million tons of fuelwood was used by the agricultural sector in 2004 (Brasil, 2006). These numbers correspond to 10% of total fuelwood consumption.

Fuelwood in Brazil is obtained from native forests and forestry plantations. Regardless of end use, fuelwood consumption in 2004 came from native forests (IBGE, 2005b). Fuelwood production from native forests is spread throughout the country but is more pronounced and intensive in Acre (AC) and Pará (PA) in the North Region; Bahia (BA) and Ceará (CE) in the Northeast Region; Mato Grosso (MT) in Center-West Region and Paraná (PR) and Santa Catarina in the South Region (Figure 5).

Figure 5. Fuelwood production from native forest municipal district level, 1991



Source: Prepared by UHLIG, A. from IBGE, 2004a.

On the other hand, fuelwood production from forestry plantation is concentrated in South and Southeast Region (Figure 6), where industry activity is concentrated. In the industrial sector, fuelwood demand represents 2.6% of TPES and 20% of the total fuelwood consumption. Food (6.4%), ceramic (6.0%) and paper pulp (4.1%) industries are the most important fuelwood consumers. Food and ceramic industries are spread over the country, with plants of diversified capacity; the pulp and paper industry is however is more "homogeneous."

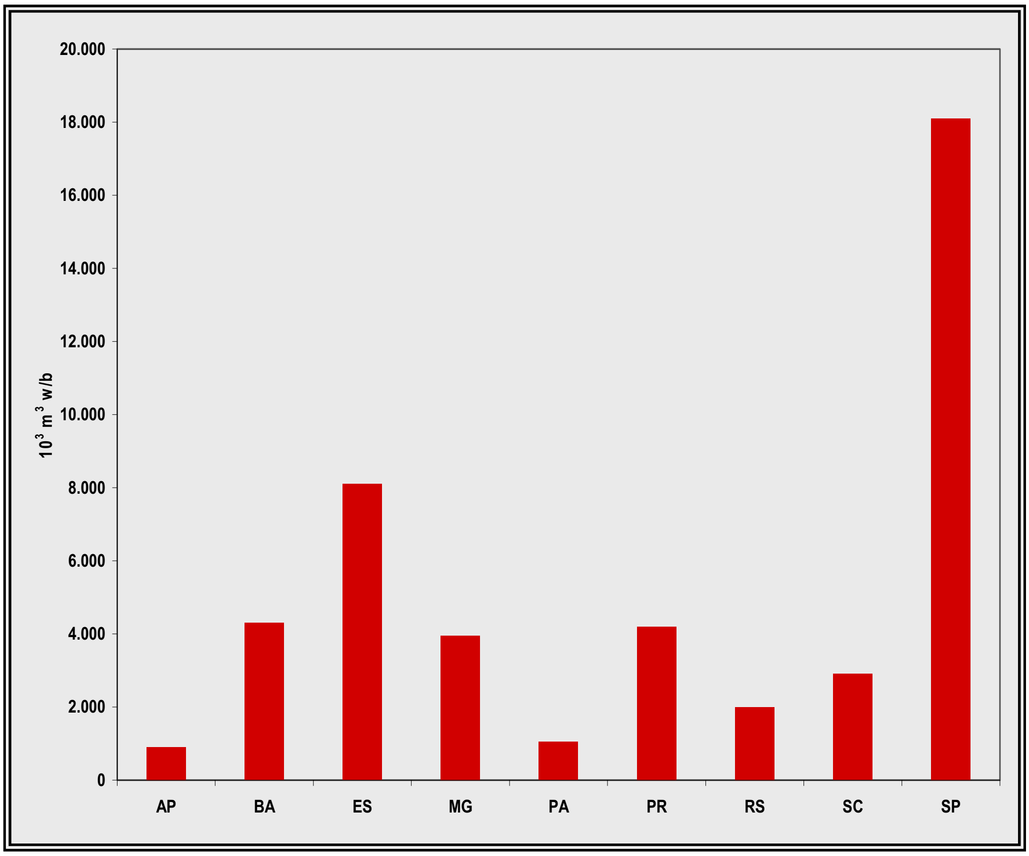
The pulp and paper industry helps to explain the concentration of the fuelwood production from forestry activities. Brazil manufactures pulp and paper exclusively from planted forests of eucalyptus and pine. The distribution of the volume of wood consumed to produce pulp, paper and fuel in each of the Brazilian States confirm this (Figures 6 & 7). It should be observed that just five states (São

Paulo, Espírito Santo, Bahia, Paraná and Minas Gerais States) are responsible for most of Brazilian wood demand in this industry. According to Bracelpa, 2007, the pulp and paper sector consumed 45.2 millions of cubic meters of wood by-products for the production of pulp and paper; 4.5 millions of cubic meters of wood wastes for the complementation of energy. In the overall process, wood residues and black liquor are also produced.

Figure 6. Fuelwood production from planted forest at municipal district level, 1991

Source: Prepared by UHLIG, A. from IBGE, 2004b.

Figure 7. Volume of wood consumed to produce pulp, paper and fuel per State in Brazil, 2005 (w/b – with bark)



Source: BRACELPA, 2007

Wood as energy in pulp and paper industry

In most Brazilian plants the cellulosic pulp is manufactured from eucalyptus wood but in some cases also from pinus. The pulping process consists of the transformation of wood in fibrous material, called paste, pulp or cellulose. The wood logs are received with bark and are processed in rotating debarking drums, generating barks as residues, which are used on steam and energy generation to the process. Rinds constitute from 12 to 18% in residues weight on the process and supply 10% of the necessary energy.

From debarking drums, the logs are led to the chippers and transformed into chips. These chips go to the digesters, where the lignin between the fibre and the wood is separated. The liberated fibres form the cellulose and the by-product of the digestion process, black liquor, which constitutes an important source of energy for the cellulose industry, supplying even 85% from the energy demand of the cellulose plants (ARACRUZ, 2007). It has lower heating value of 2 860 kcal/kg and is produced, typically, from 2.5 to 2.8 tons per tons of cellulose (NOGUEIRA; LORA, 2003). Using cogeneration systems with extraction-condensing steam turbines and live steam at pressures above 60 bars, the Brazilian pulp and paper industry basically generates all thermal and electrical energy consumed in process. The total installed capacity is 1 028 MW (BRASIL, 2006). Recent decisions towards promoting independent power production have stimulated the expansion of such systems.

Finally, it is worthwhile to introduce some questions regarding woodfuel use and deforestation. Brazil is the second country in the world with largest forest resources (FAO, 2006), with 477.7 million hectares of forest area whereby 415.9 million hectares are primary forest, 56.4 million hectares are of modified natural forest and 5.4 million hectares are of productive plantation. This total vegetal cover represents great resource availability, but about 0.8% is deforested every year (Table 2).

Table 2. Deforestation and regeneration per year in Brazil, period 1988 - 1994

Biome	Deforestation (million ha)	Regeneration (million ha)
Amazonia	1.32	1.18
Cerrado	1.27	0.25
Mata atlantica	0.08	0.03
Caatinga	0.34	0.00
Pantanal	0.14	0.05
Total	**3.15**	**1.51**

Source: BRASIL, 2004

Typically, the cycle that makes wood available to be used as fuelwood or charcoal begins with the cleaning of the sub-forest and posterior falling of trees, followed by the removal of wood for commercial use, fuelwood use or for transformation into charcoal. Finishing the process, the residues are burned to the implantation of pastures or soybean culture. In general, the land owners are interested only clearing in the area for agriculture and normally do not charge anything for fuelwood removal. In this context, the most alarming situations are those in the Amazonia and Cerrado biome, mainlydue to charcoal production. These will be presented in another study on charcoal. Also the Caatinga region in the Brazilian Northeast deserves attention, due to its fragile and semi-arid nature.

Woodfuel and environmental disaster in Brazilian Northeast

The natural vegetation of semi-arid Northeast, a sparse coverage of small trees, cactus and shrubs called Caatinga are under serious risk in large areas. Besides the usual pressure from agricultural activities expansion, the demand of wood as fuel for gypsum production in inefficient kilns is the most relevant reason for elevated rate of deforestation in Chapada do Araripe region. This region produced about 90% of all gypsum used in Brazil, representing an annual demand of about 360 000 cubic meters of fuelwood and clearing 10 000 ha every year. In addition to usual concerns on deforestation impacts, the fragile edafo-climatic conditions of this region deserve special attention, because the risks of irreversible desertification are real. In South of Piauí state, many square kilometres of Caatinga were converted in large tracts of sandy and unproductive lands.

Since the 1980's FAO has developed activities aimed to mitigate this problem, looking for ways to increase the area of forests planted with fuelwood species (basically eucalyptus, but including some leucaena) and introducing more efficient equipment and good management practices, in order to reduce woodfuel demand. In the same direction, the adoption of appropriated technology to use native forests has been promoted.

METHODOLOGICAL ISSUES

Some fundamentals

The current era is faced with several energy related challenges: Rapid and great expansion of energy demand, complexity and diversity of modern energy systems, and the environmental of energy production and use. There is therefore now a need for a comprehensive evaluation of the feasibility of energy systems in terms of two key concepts: sustainability and renewability. These two concepts should be applied particularly in wood energy and woodfuel systems.

According to the First Law of Thermodynamics energy can not be destroyed, yet effective energy sources can irreversibly be exhausted, thus converting useful energy into useless low temperature heat. For fossil fuels this concept is evident and the value of oil or natural gas reserve defines the remaining available energy. Using this principle on “depletion of energy reserves,” it is then possible to define renewability. Such that an energy source is renewable when its reserves are permanent (at least for foreseeable future) or can be refilled in accordance to use. Thus, observing that energy renewability is related to the type of energy source, in principle and in appropriated conditions, woodfuels, e.g. fuelwood or charcoal, are renewable sources of energy since they are able to regenerate permanently. Under a more rigid concept for any biofuel, renewability may result to zero emission of CO_2, but is impossible to achieve because in agro- industrial processing some amounts of conventional fossil fuels are always used (BERC, 2004). Nevertheless, net emission of CO_2 is a good indicator of the renewability for woodfuels sources.

The Brundtland Commission has defined sustainability as the ability of the present generation to meet current needs without reducing future opportunities within the purview of social, environmental and economic frameworks. To examine and understand the idea of effects and implications of energy systems vis-à-vis the concept of sustainable development is not a simple task. One needs to consider several factors. For one, sources and origins of energy production, processing, transportation, and consumption patterns have to be accounted for. On the other hand, sustainable development requires sound, stable, productive development which does not deplete natural resources and is economically feasible and socially acceptable.

The criteria used in the Santiago Declaration 1995 could serve as a model for wood energy systems sustainability goals. The Declaration consists of basic/ general biodiversity objectives, maintenance of productive capacity, soil and water conservation, among others. The entire document is divided into 67 parameters meant to quantify sustainability and eventually leading to the certification of forest products (USDA, 1996). The country of Brazil should consider this model as a good example.

Sustainability is a broad subject particularly when it involves ecosystems and energy flows. Perhaps a definition for sustainability more appropriate in bioenergy systems is "the amount of consumption that can be continued indefinitely without degrading capital stocks - including natural capital stocks" (Goodland *et al.,* 1992). In this definition, it is feasible to evaluate soil fertility preservation or degradation and water resources maintenance in order to obtain sustainability of wood energy systems. All these studies impose long-term analysis, and a relevant quote to all these is from an Indian old proverb: “a forest well managed can supply seven generations” (IEA/Task 29, 2005).

While the sustainability of bioenergy systems is a formidable question to bear, suffice it to say that it is worthwhile to identify what factors cause the "non-sustainability" of these systems. One important starting point is the supply and demand balance for woodfuels as a valuable indicator of sustainability. If the supply of woodfuels is greater than its demand for a long-term, it is an assurance for "sustainability." In this case, the social, economic, and environmental aspects need to be factored in so as to complete the evaluation of sustainability.

Woodfuel data in Brazil: a critical review

No regular exhaustive statistics is kept about the production of fuelwood in Brazil. It is also very difficult to estimate stocks of fuelwood built up by retailers and individual consumers. Therefore the conventional assumption is that production of fuelwood is equal to consumption. Another assumption is that variation in stock and the import-export balance are negligible. The official data of wood demand for energy is estimated based on methodologies established about 30 years ago and may no longer be relevant to present day reality. New procedures for woodfuel demand estimation are being discussed to improve future data quality.It is therefore important to manage Brazil's woodfuel statistics as professionally and scientifically as possible.

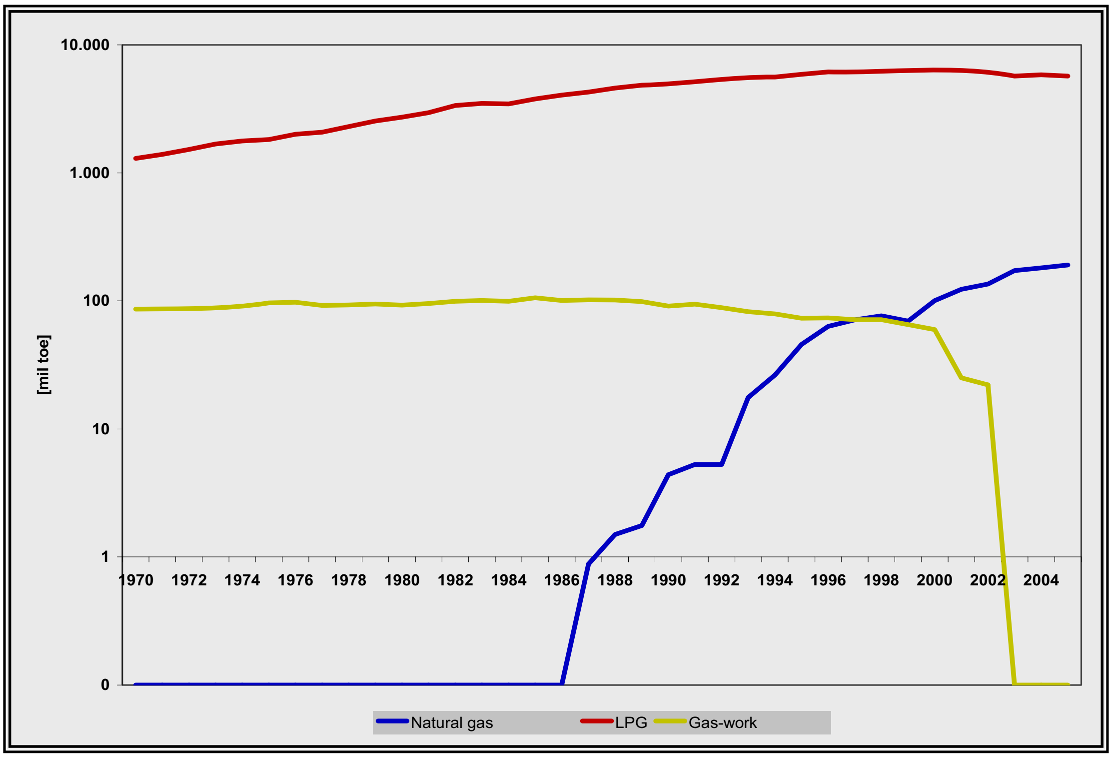
For the residential sector, the National Energy Balance uses the correlation with LPG. This considers the sum of useful energy necessary for cooking family food and it is based on the IBGE statistics. The statistics revolves around about the number of stoves by kind of fuel and obtained on prompt researches conducted in some states. For residential sector alone, the estimated consumption of woodfuel is about 10 millions of m^3/year or 5.2 millions of ton/year (BRASIL, 2006). For the other sectors, as agriculture, ceramics, foods and beverages and other industries, the estimates are done taking into account that the woodfuel consumption behaves according to the commercial energy demand and the aggregated value of the sector. Data from IBGE, of the extraction of native forests products and of planted forests along with data from census and economic researches are used as estimates.

It can be affirmed that the woodfuel production and consumption statistics and estimations used by the Brazilian Energy Balance in all sectors are unreliable and vulnerable. However, the improvement of the production and consumption statistics of forest products and forest by-products can still be ascertained by developing a better and more relevant estimation methodolgy. Moreover, the quality of the data becomes more realistic when these estimates are subjected to the objectives of the National Energy Balance.

Among the sectors of economic activity that uses intensively the forest products and by-products are found in manufacturing. Along this line, it is observed that only the pulp and paper sector and some companies in the metallurgic sector produce a more systematic accounting of production and consumption. These sectors are large producers and consumers of forest products in terms of volume and weight.

The evaluation of fuelwood used in residential sector as a supplement or complement to LPG presents problems and lack of precision. For instance, when the LPG prices increase, in theory the elasticity effects on the consumption of LPG is said to decrease as a consequence. It does not always follow however that there will be an escalation in fuelwood consumption. In the recent past, a press release noted that there was an increased demand for woodfuels as a result in a decreased consumption for LPG (Soares, 2006). This was not true as the displacement in LPG was more due to the increased in natural gas consumption from 5 to 217 million cubic meters during the last 15 years. This was prompted by the expansion of natural gas grid distribution (Figure 8). Aside from the increased availability of natural gas, LPG consumption was also replaced by more electricity use as urban families were now using more electrical appliances i.e. microwave ovens, coffe and tea makers, among others. Despite the increased consumption in natural gas, it is still unsafe to say that all LPG can be replaced by natural gas and electricity in large urban centers.

Figure 8. Gas consumption in households in Brazil



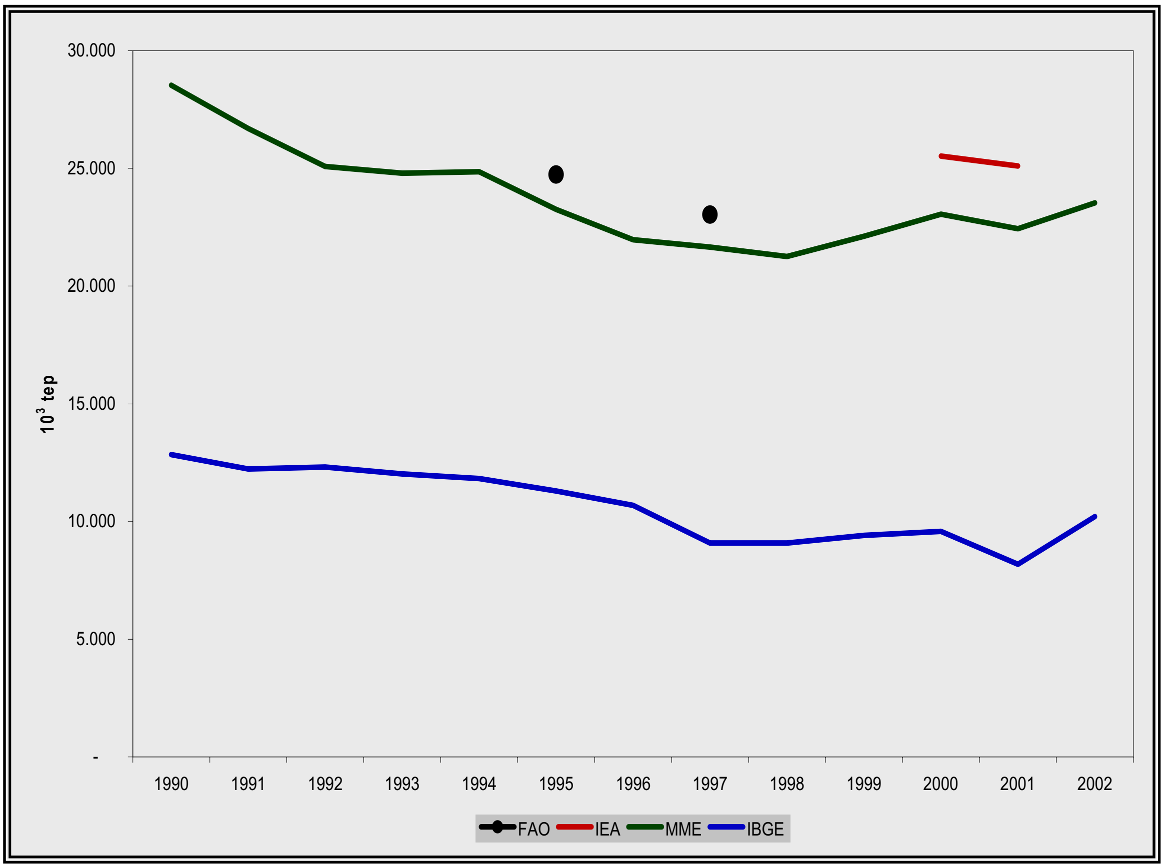
Source: BRASIL, 2005

Estimation methodologies should also consider modern improvements in LPG stoves. LPG stoves are now more efficient. In terms of energy contents, 3 kg of fuelwood corresponds to 1 kg of LPG. However, woodfuel stoves are four times less efficient than LPG stoves such that it may be necessary to have 12 kg of fuelwood to supply the same amount of useful energy in only 1 kg of LPG for cooking applications. Along this line, during the past two years, the National Labelling Program for Energy Efficiency induced a gain of 15% in average efficiency of Brazilian gas stoves. Labelling stimulates the rationalization of energy consumption, allowing consumers to evaluate products based on their energy income and select the more efficient ones. If we assume that each family consumes, on average, one bottle of 13 kg of LPG each month, the potential savings of the Program is about two bottles of LPG per family per year (BRASIL, 2007). It is estimated that this program, under CONPET (the National Program of Rationalization of Petroleum Derivatives and Natural Gas) and INMETRO (the National Metrology Institute) has the potential to save about 780 thousands of tons of LPG annually. It will also decrease importation of LPG. Again, this reduced demand in LPG was brought about by improved LPG stove efficiency and therefore the reduction was not replaced by woodfuels.

Aside from the problems related to the fuelwood consumption estimation in households and the difficulty on obtaining information from the service and industry sectors, there is a significant amount of wood residues coming from sawmills and from the furniture industry. These are could also be used in energy production or conversion into charcoal (MONTEIRO, 2000) and is probably is not included. The potential conservative estimates were done by Coelho, Paletta and Freitas (2000). Accordingly it can reach 7.5 millions of tons of wood residue, where 2.8 millions of tons originate from the states north of the country and 4.7 millions of tons from the states that receive the wood, mainly South and Southeast of Brazil.

Figure 9 presents the contribution of woodfuel to the Brazilian total primary energy supply from 1990 -2002. The data is derived from IBGE (the Brazilian National Statistics Agency) and MME (the Ministry of Energy and Mines). Various methodologies were used to estimate these values which affected the presentation of the results. While IBGE data were generally industry field studies and direct surveys, MME values were correlated indirectly with social and macroeconomic indicators. A closer study is needed to address these differences. In addition, figures from IEA (International Energy Agency) and FAO were also included in this figure, indicating that these agencies may have used adjusted data from MME for woodfuel demand and could raise the total woodfuel demand in some amount.

Figure 9. Woodfuel total primary energy supply - TPES in Brazil



Sources: BRASIL (2003); FAO (2004); IBGE (2004 a & b) and IEA (2003)

Sustainability and renewability issues

In order to evaluate Brazil's woodfuel demand and supply vis-à-vis their environmental implications, it is useful to separate residential and industrial contexts. In the residential sector, local air quality and health concerns can be related to woodfuel utilization, cooking practices do not seem to pose any serious implications for the environment, i.e.land degradation and regional air pollution. The depletion of forest cover should not be attributed to the demand for fuelwood in Brazilian households. Fuelwood is more often gathered from the roadside and trees outside forests, rather than from natural forests. Studies at the regional level indicate that as much as two thirds of fuelwood for cooking worldwide comes from non-forest sources such as agricultural land and roadsides (ARNOLD *et al.,* 2003). In this way, woodfuel in the residential sector can be considered renewable and mostly sustainable, at least in energy terms.

The clearing of land for agricultural development and timber are the main causes of deforestation in Brazil. The demand of woodfuel in some industries however presents evident negative impacts. For instance, in the Northeast where ceramic stoves and lime pits exist. In these cases, woodfuels are non-renewable and unsustainable, and is associated with impoverishment and desertification. It is not possible to quantify the unsustainable fuelwood share in the industrial sector, yet there are some indicators that exploitation of wood may have been declining. The main reasons are:

- substitution by wood from reforestation,
- higher efficiency in the use of the energy source (increased quality of fuelwood),
- implementation of better and modern end use technologies and
- fuel substitution (LPG, natural gas, electricity).

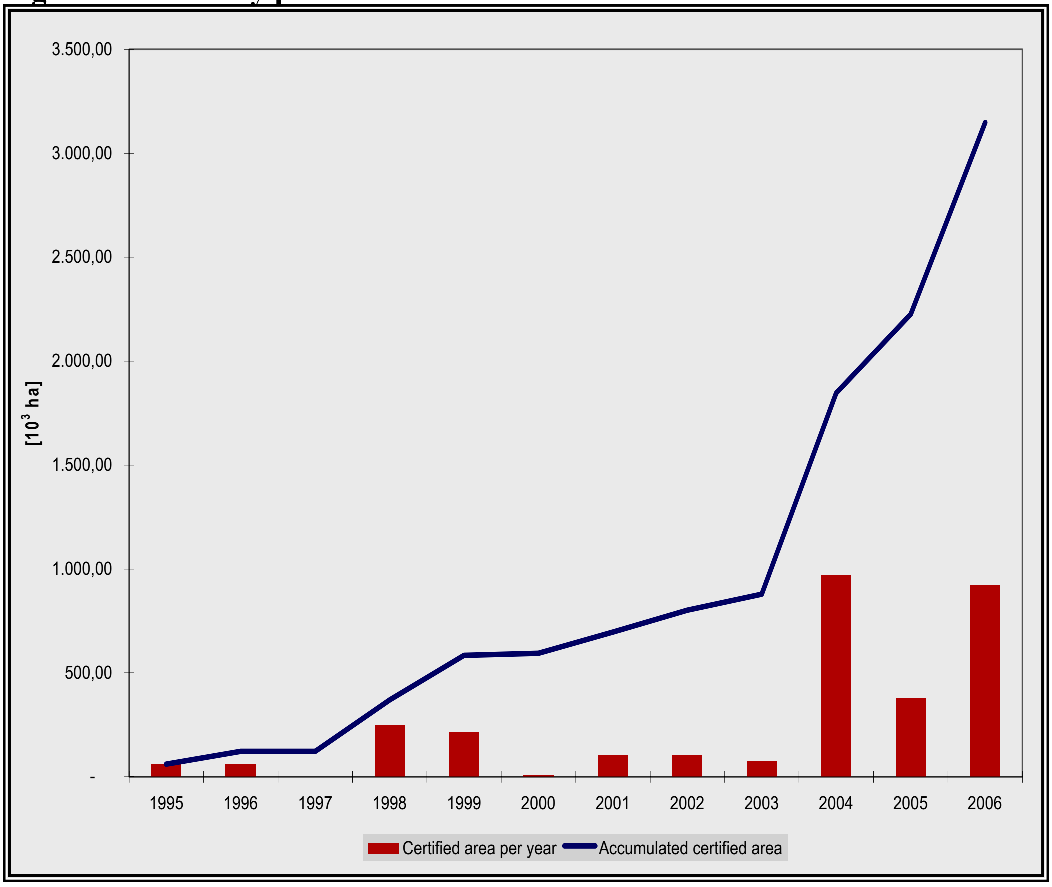
The pulp and paper industry could be assumed as a model for wood use in Brazil, included for energy production. According to Bracelpa, 2007, 96% of reforested area for pulp and paper industry was certified, indicating that good renewability and sustainability indicators have been obtained and are being monitored. The certified reforested areas are located in eleven Brazilian States: Amapá and Pará States in North Region; Bahia and Maranhão States in Northeast Region; Espiríto Santo, Minas Gerais and São Paulo States in Southeast Region; Paraná, Santa Catarina e Rio Grande do Sul States in South Region and Mato Grosso do Sul in Center-West Region. Add to that, the pulp and paper industry in Brazil is responsible for the growing of certified reforested areas in Brazil. It is estimated that 60.7% of the total reforested area in Brazil corresponds to certified forests, mostly in the pulp and paper sector. These has been growing quickly especially in the last three years (Figure 10). Fourteen companies were certified in 2006. From the 77 companies certified for forest handling, 49 feed the pulp and paper sector and 8 are certified to supply wood for energy ends; fuelwood and charcoal (FSC,2007; INMETRO, 2007).

Besides forest certification in the pulp and paper industry, there are also production processes certified in the charcoal industry. Amongst the products of 192 certified companies, 16 are related to energy production, three in charcoal production at Minas Gerais State, one in fuelwood production, five in shaving production and seven in cellulose production. Over the last three years, 90% of these products have been certified. These are signs of the growing concern in regulating the origins of woodfuels and improving the sustainability of the forest resources (FSC, 2007).

Certified forests and wood products

Certification is a voluntary process to promote responsible management of the forests. There are two kinds of certification: forest management – FM certification and chain of custody - COC certification. The forest management certification involves an inspection of the forest management unit by an independent accredited certification body to check that the forest complies with the internationally-agreed principles of responsible forest management defined by the institution. If the forest complies with standards, then the accredited certification body issues a certificate for the operation. Certified forest operations can claim the forest products they produce from a responsibly managed forest. Chain of custody certification provides a guarantee about the production of certified products. Chain-of-custody is the path taken by raw materials from the forest to the consumer, including all successive stages of processing, transformation, manufacturing and distribution. The institutions that accredit independent third party organizations that can certify forest managers and forest product producers are detached Forest Stewardship Council – FSC and Programme for the Endorsement of Forest Certification – PEFC Council. The Brazilian Program of Forest Certification – Cerflor of Instituto Nacional de Metrologia, Normalização e Qualidade Industrial - Inmetro has been endorsed by the PEFC Council as meeting their requirements for forest certification schemes. There are five organizations accredited by FSC and Inmetro in Brazil that can certify forest managers and products: Bureau Veritas Certification – BVQI, Instituto de Manejo e Certificação Florestal e Agrícola – Imaflora, Scientific Certification Systems – SCS, SGS do Brasil Ltda. and Skal. (FSC, 2007; INMETRO, 2007)

Figure 10. Forestry plantation certified area in Brazil



Source: FSC, 2007 and INMETRO, 2007.

CONCLUSIONS

Brazil and its forest is a living paradox. This country has one of the biggest native forest cover in the planet (416 millions of hectares, or 31% of native forest covert in the planet) and has the fifth biggest reforested area in the world. However, there is scarcity of wood in Brazil, for all uses including energy.

This situation will have to be addressed by formulating policies particularly in regard woodfuel production, conversion efficiency, and final consumption-related guidelines. . Although the whole wood energy chain is formed by private stakeholders, the government should play a central role by launching initiatives and creating regulatory, economic and fiscal directions, consolidated in a National Policy for Wood Energy. Following are some proposals:

- Identify long-term production targets and timetables aimed at increasing supply and reducing costs of wood used for energy purposes;
- Create an organization, preferably at the regional level, that will be responsible for the establishment of a National Wood Energy Information System. This organization will be tasked to develop consistent methodologies, conduct of surveys, sourcing of funds and resources, information dissemination, and the preparation of annual wood balance report.
- Define norms and standards on wood energy systems preferably similar to "Certification" techniques and methods. These standards should be aimed at promoting efficiency, reducing losses, and increasing sustainability.
- Develop conditions for forestry-related scientific and technological development i.e. forestry and wood energy process, and expertise in production, conversion and management of wood energy systems.
- Enforce regulations not only in transportation of wood but also in its final use.

The last proposal is very relevant. The use of fuelwood in Brazil is regulated but the enforcement is quite fragile. Recent initiatives of Sao Paulo State (Decrees 4967 and 49674, 2004) were aimed to improve enforcement in roads and the use of sustainable native wood in all governmental purchases. The Federal Government is also introducing changes in fuelwood control, devolving the responsibility to the States. However, difficulties such as the lack of local capacity and of inadequate funds still exist.

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3. Sustainable charcoal production in Brazil

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INTRODUCTION

Charcoal has been used as a source of thermal energy since the beginning of the steel industry in Brazil. Charcoal is used in the production of metallic iron from ore. Due to non-existence of sulphur in its composition, charcoal improves the quality of pig iron and steel produced. This phenomenon allows the steel industry to command attractive prices, Today, Brazil produces about 10 million tons of pig iron using charcoal, 60% are exported, generating an income of US$ 2.0 billion per year.

Pig iron is produced in two regions in Brazil. The first one is at Minas Gerais metallurgical region, located near the centre of Southeast Brazil. Back in the 15th century, iron mines and charcoal were already produced in these areas mainly from planted eucalyptus forests or imported from neighbouring states. Fuelwood used typically comes from native forests.

The other region is East Amazonia, along the railroad between the Carajás mineral district and the Itaqui harbour, in Pará State. The furnaces in Carajás have been in operation only recently, in the last two decades, to be exact. Since then, their production has grown significantly at an annual rate of 17.5% and currently reached 40% of total Brazilian pig iron production. The pig iron production in this area comes from charcoal that originates from from logs and residues. Take the case of one company, Companhia Vale do Rio Doce – CVRD. It produces 5% of total pig iron, and has planted forests to supply its charcoal demand. The demand for fuelwood to supply the charcoal consumed in Carajás is estimated to be at 12 million cubic meters per year. This translates to clearing around 200 thousand hectares of forests every year. Just for comparison, the 3,500 sawmills operating in Amazonia process 24 million cubic meters of wood annually.

There is now a growing concern about the future supply availability of charcoal. In order to understand these questions, this study will identify charcoal flows from different regions, describe briefly the process units involved with charcoal production, identify basic aspects in charcoal production and propose some criteria and indicators in order to improve the sustainability of this activity.

CHARCOAL SUPPLY AND DEMAND IN BRAZIL

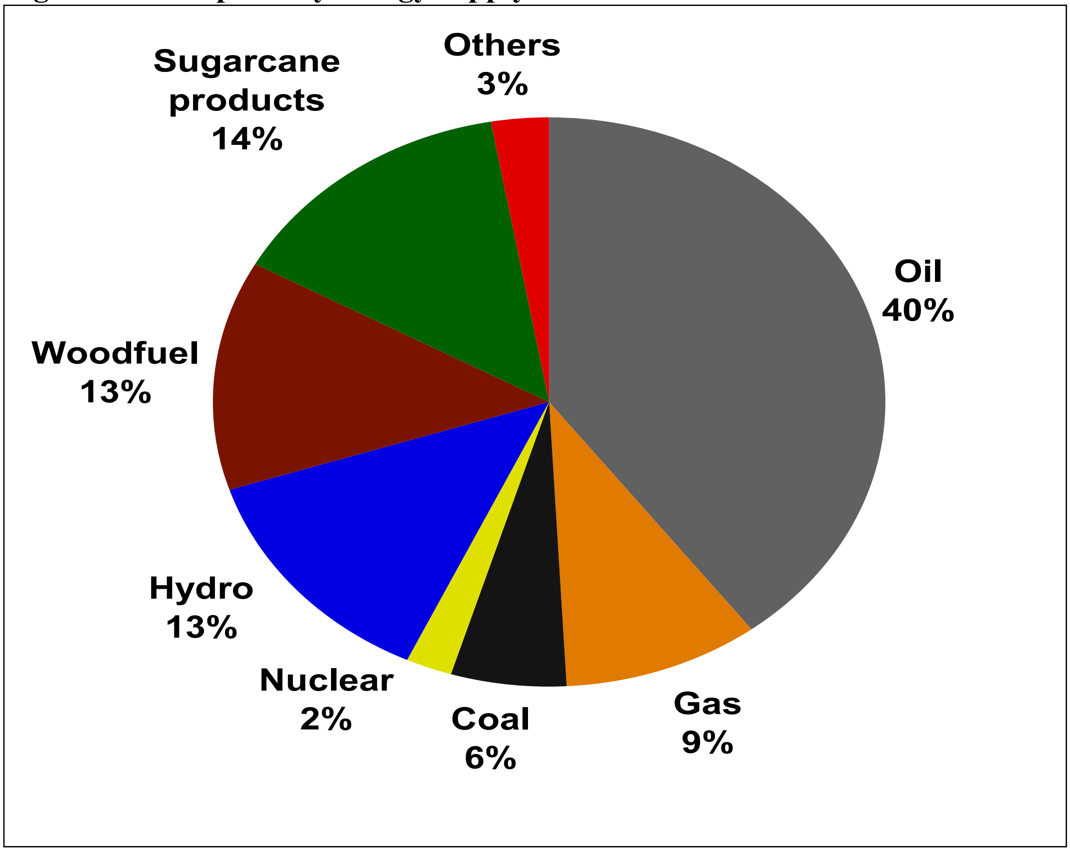
Energy use has been growing rapidly in Brazil. Total energy consumption nearly doubled between 1975 and 2000. Energy consumption per capita increased by 60% and energy consumption per unit of Gross Domestic Product (GDP) increased by 22% (GELLER *et al.,* 2004). Rapid industrialization, high growth in some energy-intensive industries i.e. aluminium and steel production, and the increasing residential and commercial energy services are among the main causes of increased energy use and energy intensity (TOLMASQUIM *et al.,* 1998). Total primary energy supply (TPES) grew in average around 2.5% per year in the last 20 years. This number is slightly higher than the annual economic growth rate of 2.1% during this period.

Energy policy in Brazil in the last three decades attempted to reduce the country's dependence on foreign energy supplies and stimulate the development of domestic energy sources, mainly from hydrocarbons. Also during this period natural gas and hydroelectricity production increased steadily over time; oil consumption decreased in the first half of the 1980s, but since the oil counter shock in 1986, it has been recovering its market share. The demand for coal increased due to the metallurgical sector while the residential sector decreased due to fuelwood substitution.

According to the Ministry of Mines and Energy, 13% or 28.4Mtoe (2005) of TPES is provided by woodfuels (Brasil, 2006). This is almost at the same level with the rate supplied by hydropower generation. Despite the importance of woodfuels in the energy mix, the demand for woodfuels steadily decreased from 1970 to 2000. In 2004 however, the trend reversed as woodfuel demand rose to the level similar to that during the 1980's (see Figure 2).

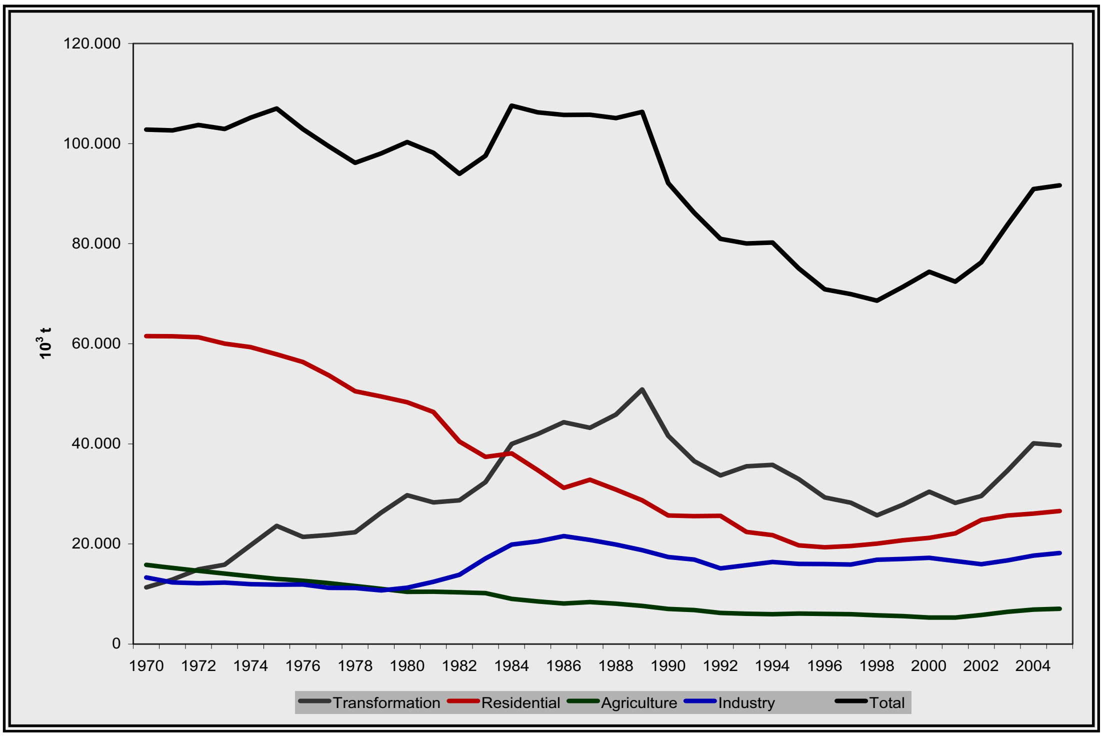
A strong driver in the decreasing consumption of woodfuels was the increment on the conversion into charcoal, as presented in Figure 2, this was directly related to the increase in the pig iron production in Brazil, Figure 3. Around 43% or 91.7 Mt of fuelwood consumed was converted in charcoal in 2005 (BRASIL, 2006). This charcoal was almost totally used in industry and residential sectors, as shown in Figure 4. These data were obtained from National Energy Balance issued by Ministry of Energy and Mines. It is important to note that some inconsistencies were observed.

Figure 1. Total primary energy supply in Brazil in 2005



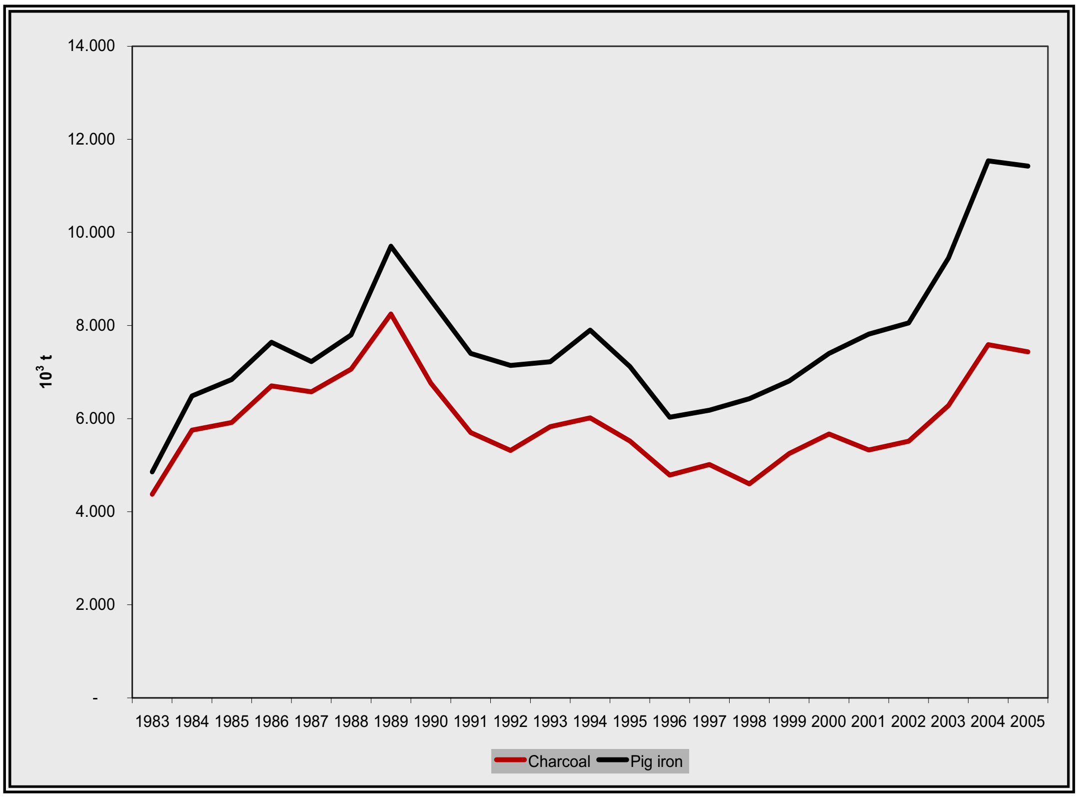
Source: BRASIL, 2006.

Figure 2. Woodfuel consumption in Brazil



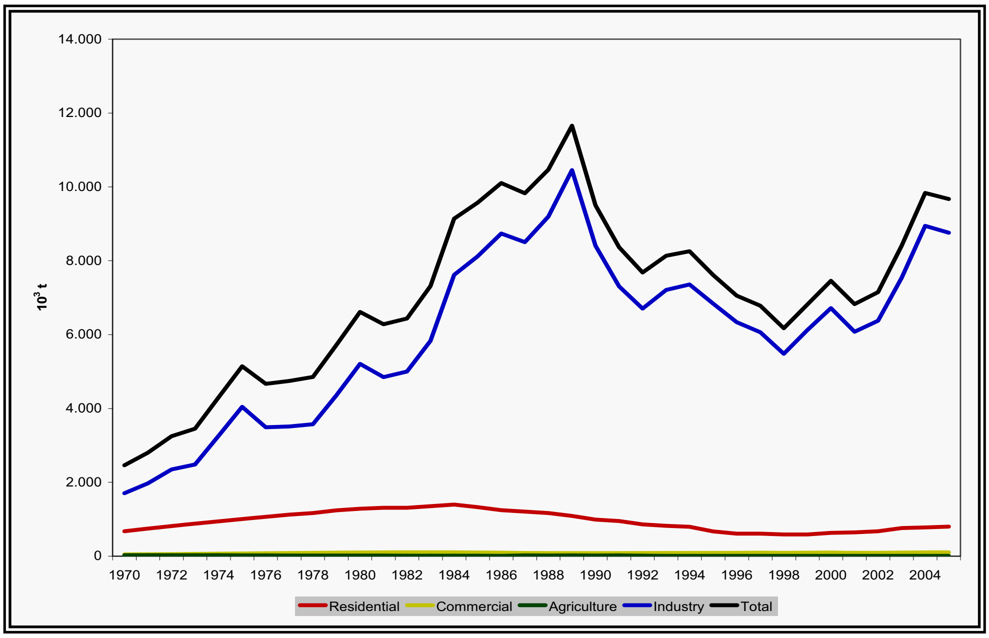
Source: BRASIL, 2006

Figure 3. Pig iron production and charcoal consumption



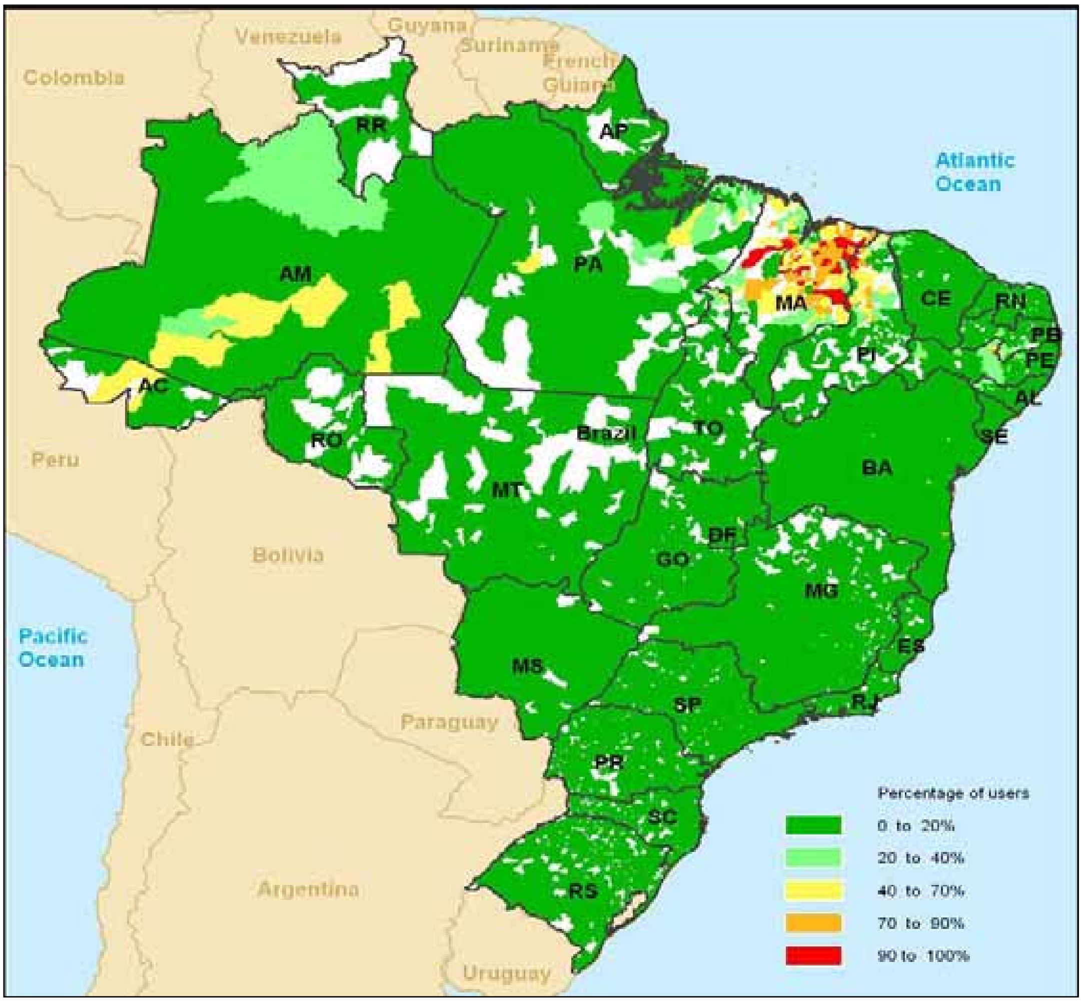
Sources: SINDIFER, 2007; BRASIL, 2005

Figure 4. Charcoal consumption in Brazil



Source: BRASIL, 2006.

Figure 5. Saturation of exclusive charcoal user at municipal district level in Brazil, 1991



Source: Prepared by UHLIG, A. from IBGE, 2004c.

In the last six years, charcoal demand has remained constant particularly in the residential sector. This represents 8.3% of total consumption. It is estimated that in this sector, 635.8 thousand houses or1.3% of national total, consume charcoal for cooking (circa 2003) at practically equal levels in urban and rural areas, as indicated in Table 1 (IBGE, 2004d). Percentage-wise this value may be small, but this translates however to the fact that in Brazil there are now approximately 2.4 million people relying on charcoal for food preparation. The charcoal consumption in residential sector can be traced in the Northeast municipalities, chiefly in Maranhão and Piaui States where by 20% of the houses use charcoal for cooking (Figure 5). It is believed that the source of charcoal for these houses comes from excess charcoal supplied to pig iron production at Carajás Region in Pará and Maranhão States (Figure 6).

Grilled and or barbequed food preparation is a matter of culture among Brazilians regardless of socioeconomic class. This is among the reasons why many households use multiple fuels e.g. charcoal and LPG to supplement or complement each other (Table 1). This is particularly true in the urban areas where charcoal bags (primarily to be used in grills) are sold in every supermarket and or gas stations in Brazil.

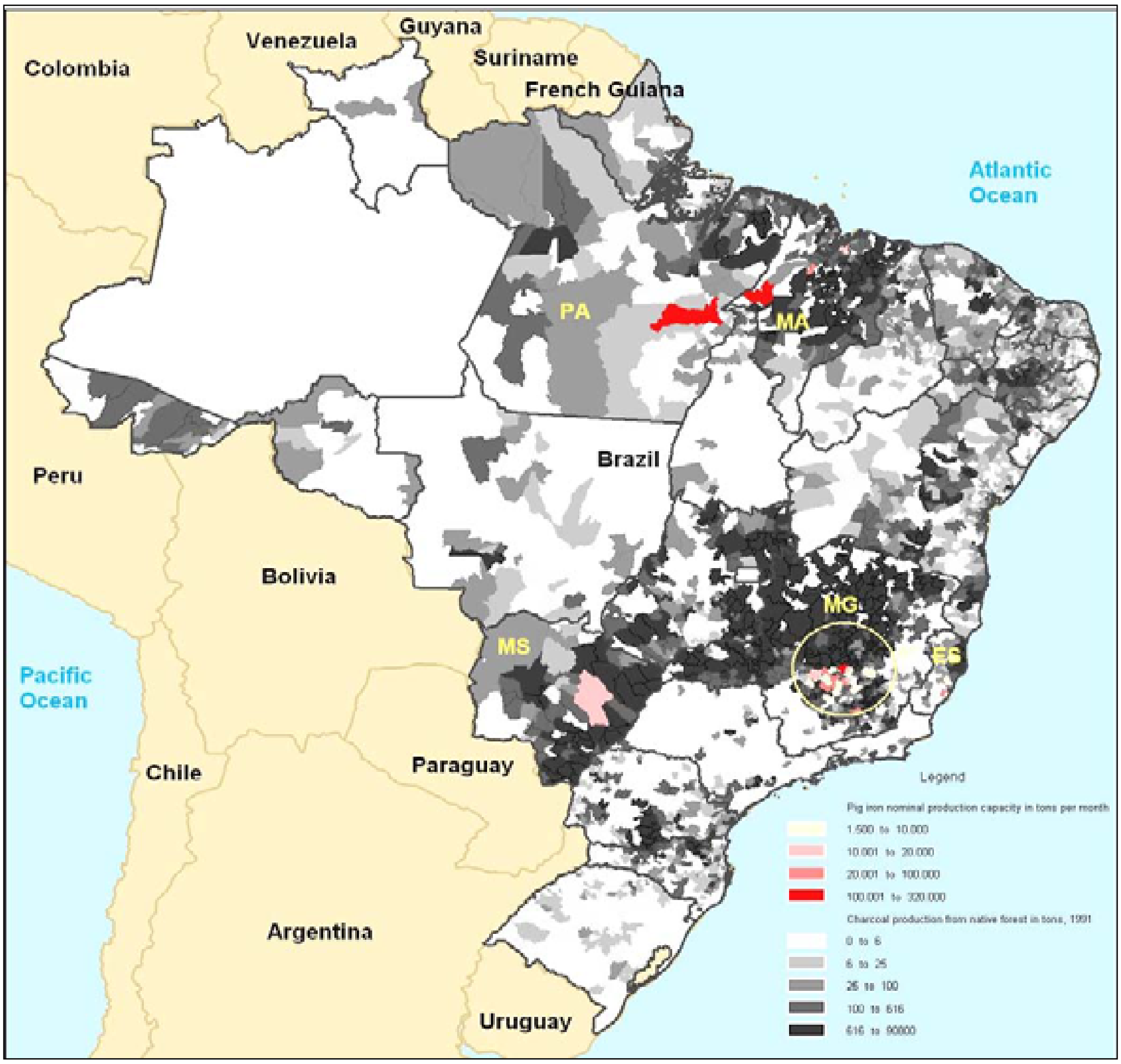
In the agricultural sector, charcoal consumption is not significant, representing only 0.1%. In the commercial and services sector, charcoal use is a bit larger and represents 1.1% and mainly used in restaurants (BRASIL, 2006). These information must be handled with care considering that it could be overestimated in some sectors e.g. residential and could also be underestimated in others e.g. industry and agriculture.

Table 1. Household consumption by fuel and situation in Brazil in 2003

Fuel	Urban	Rural	Total
Only LPG	31,916,473	2,480,533	34,397,006
LPG and fuelwood	3,007,274	4,096,489	7,103,763
Only fuelwood	462,382	1,312,046	1,774,428
LPG and charcoal	4,248,244	874,777	5,123,021
Fuelwood and charcoal	89,244	270,041	359,285
Only charcoal	323,916	311,889	635,805
LPG, fuelwood and charcoal	387,338	442,242	829,580
Total	**40,434,871**	**9,788,017**	**50,222,888**

Source: IBGE, 2004d

Figure 6. Charcoal production from native forest in 1991 and pig iron nominal production capacity at municipal district level in Brazil.



Sources: Prepared by UHLIG, A. from IBGE, 2004a and SINDIFER, 2007.

The industrial sector consumed 8.7 Mt of charcoal, representing 90.5%of total demand in Brazil. In 2005 the main consumers were pig iron production (84.9%), steel alloy production (10.1%) and cement fabrication (4.4%). As mentioned earlier, pig iron production is the principal user of charcoal in Brazil. Charcoal consumption pattern corresponds to pig iron production patterns.

Brazil has two important metallurgical poles for pig iron and steel production: the Carajás Pole (located in Maranhão and Pará States in North Region , and the other, the Minas Gerais State (located in the Southeast Region). Both poles produce 3.2 million and 5.8 million of pig iron respectively in 2005. This represented 92.3 percent of national pig iron production. In Maranhão State, there was an expansion of metallurgic companies after the beginning of iron ore exploitation at Serra dos Carajás. Charcoal was the preferred energy input to transform iron ore into pig iron.

Charcoal in Brazil is primarily originates from native forests exploration despite the moves to produce charcoal from planted forests. In 1990, 60.3% of Brazil's charcoal production came from native forests and in 2005, this percentage decreased to 53.0%, (Associação Mineira de Silvicultura – AMS). It is important to observe the spatial distribution of this production, as shown in Figures 6 and 7, respectively for native and planted forests. It is clear that the production of charcoal from planted forests occurs mainly in Southeast of Brazil.

The states that produce charcoal in Brazil are Minas Gerais, Mato Grosso do Sul, Maranhão, Bahia and Goiás. In 2004, their production statistics were as follows: 47.8%, 13.3%, 11.6%, 9.6% and 8.2%, respectively of national charcoal production (BACHA, 2006). The presence of pig iron companies in the area determines the concentration of charcoal production in the said regions. Typically , charcoal supplies come from within a radius of 200 km radius from these poles, marked with a yellow circle in Figures 6 and 7.

Figure 7. Charcoal production from forestry plantation in 1991 and pig iron nominal production capacity at municipal district level in Brazil.

Sources: Prepared by UHLIG, A. from IBGE, 2004b and SINDIFER, 2007.

In the 1990s, two tendencies on the charcoal used in the North were observed. The first tendency was that of a reduction of charcoal derived from deforestations and the growth of charcoal derived from sawmill residues. The second tendency was the increase in the distance from the biomass sources to the charcoal production in relation to the pig iron companies.

However, charcoal consumed in the Southeast of Pará and in the East of Maranhão still came from places close to the plants, as compared to the long distance covered by the charcoal consumed on the southeastern part of the country, where charcoal was transported beyond 800 kilometers. Apparently, charcoal production from forestry plantation was primarily near the biggest pole at Sete Lagoas, municipal district of Minas Gerais State. In reality, charcoal production did not take place near Carajás Pole.

Pig iron production diagnosis in Maranhão and Pará States

The pig iron industry on Pará and Maranhão States grew strongly on the last years basically due the proximity with the Carajás Iron Ore Mines, located in Pará State and the significant local availability of wood and wood residues for charcoal production. In 2005, in order to evaluate environmental conditions and impacts of such activity, officials from Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis -IBAMA made a huge operation on this region. Thirteen pig iron companies were visited to verify the process of charcoal supply and the legal conditions regarding charcoal production. A great part of the companies buy the charcoal from thirds or make supplying contracts with charcoal kilns operators installed on deforested areas that use fuelwood and residues.
To check the actual consumption of charcoal on these pig iron companies, IBAMA used the typical specific consumption parameters (in charcoal production, about 0.50 cubic meter of charcoal per stereo cubic meter of fuelwood and for iron ore reduction, by 2.9 cubic meter of charcoal per pig iron ton produced). With this approach, the consumption of charcoal could be estimated from pig iron production data, allowing concluding that 67% of the visited companies presented problems in charcoal demand information. It had estimated a difference of 7.8 millions cubic meters of charcoal between the real consumption and the declared by pig iron companies from 2000 to 2005. From the total volume of charcoal declared as used by the visited companies, totalled from 2000 to 2004, 14.2 millions of tons, only 7.5% comes from reforestation, while 55.7% comes from sawmill residues, 20.1% from deforestation, 12.2% from babassu and 4.5% from residue handling.

This mission demonstrated the strong pressure that the metallurgic pole on Pará and Maranhão States has done over the forest resources. The exploitation of authorized deforestation residues has been shown the easiest way for charcoal supplying in these pig iron companies that still have not become aware of the urgent necessity to obtaining such product on a more sustainable route. IBAMA indicates that according to the Forest Code it can apply fines of about US$ 18.2 millions, besides to oblige the reforestation of 60 thousand hectares (IBAMA, 2005).

SUSTAINABILITY ISSUES

Government agencies in Brazil have produced data pertaining to the production and consumption of charcoal for more than 30 years. Despite advances in estimation methods, the results still presented problems and deviations. Hence information found in this document should be dealt with caution. In 2006 the Ministry of Mines and Energy announced that a study was being developed to implement new methodologies to review the woodfuel data so as to improve its quality. To estimate charcoal consumption, primary surveys at national and regional levels were recommended. It was also pinpointed that the estimation methods should take into account consumption sites, fuel characteristics, and size of the industry.

A difficulty that remained was how to estimate charcoal supply and availability. Some proposals were studied that considered productivity of the forests by biome and using Geographic Information System (GIS), similar to that of WISDOM methodology as developed by FAO Forestry Department .

Sustainability and economics of charcoal in Brazil

Charcoal produced in Brazil is of industrial scale. The process involves carbonization of wood in poorly mechanized masonry kilns highly dependent on human labour. Despite the traditional procedures, according to IBGE (2006) commercial charcoal revenue earned in Brazil amounted to 5.5 millions tons in 2005 which generated US$ 785 millions in sales. These charcoal were obtained from both native forests (52.8%) and forestry plantation (47.2%) as shown in Figure 8 (AMS, 2007).

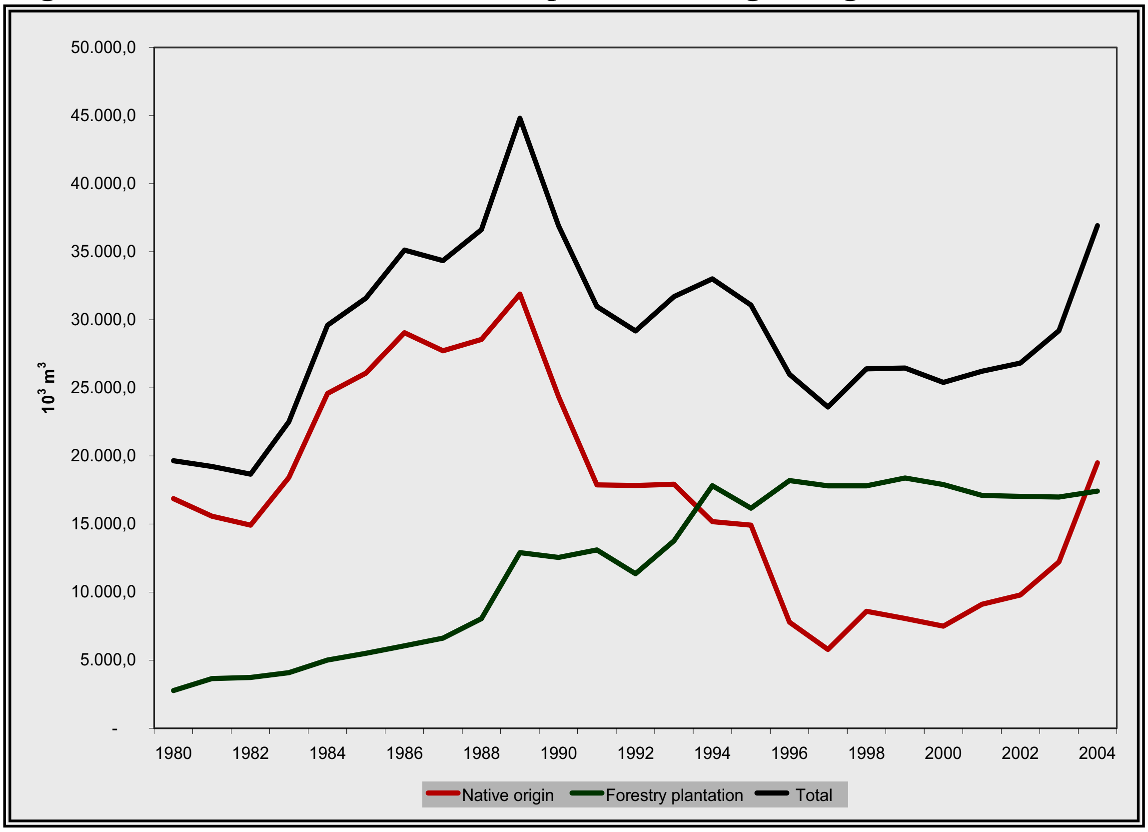
One observation is that charcoal produced from native forests decreased to 82% from 1989 to 1997, but it rose again after 1997, as a result of increased pig iron production in the North of Brazil. On the other hand, charcoal can also originate from: agricultural expansion, sawmill by-products, legal and sustainable logging, and illegal logging. As a whole however, it is estimated that charcoal production has recently caused deforestation at a dramatic rate of 200 thousand hectares per year.

The sustainability of charcoal-based pig iron production from native forests is becoming difficult. Native forest resources are becoming limited.As a result, the distance between charcoal sources and pig iron companies has increased. It is possible to observe charcoal being transported to as far as one thousand kilometers in order to reach consumer zone (BRITO, 1990), as shown in Figure 6. This situation induces pig iron companies to develop reforestation programs using rapid growing species to meet their charcoal demand (AMS, 2007).

Despite reforestation efforts, government surveys show that in Minas Gerais State, the main pig iron producer state, at least 11.5% of charcoal production from native forests comes from illegal sources and in the last three years, about 6,600 hectares were deforested to produce charcoal (MINAS GERAIS, 2007).

The exact figures of forest felled every year for charcoal production is not known. Hence the total extent of forest resources affected and the agents of deforestation are also not clear. However, these issues on management, accountability, inter-ministerial coordination and the sharing of forest revenues are becoming increasingly important and should be included in governmental agenda.

Figure 8. Evolution of charcoal consumption according to origin



Source: AMS, 2007.

Another relevant problem in promoting sustainable charcoal production is related to the prices for charcoal and other wood products. According to 2005 figures, reforestation for charcoal production was not encouraging because the price paid for charcoal was, in average, US$ 34 per cubic meter, while cellulose was evaluated by US$ 600 per ton in the same period. Thus, particularly during periods of low prices for pig iron, independent companies paid the lowest price for the charcoal, which can be produced profitably just using very low-priced feedstock.

Charcoal acquisition represents a large percentage in pig iron production costs averaging to as much as 40%. Therefore, charcoal is a main input for which pig iron producers tend to control to protect their profit margin. As the cost of the charcoal produced from planted forests reaches US$ 100 per ton, a value much higher than charcoal produced from native forest, it can make the pig iron production impractical (relative to international prices). Although in 2006 pig iron was commercialized at US$ 230 per ton, in 2002 exported pig iron was only US$ 103 per pig iron ton (Monteiro, 2005).

The dependence of pig iron makers on charcoal is so high that in 2004, when the international prices of pig iron rose to US$ 300 per ton, because of incrased demand from China, charcoal supply became a real concern for companies. When it happened, all the available wood was used to produce charcoal at Minas Gerais State and during those months the price of charcoal per cubic meter reached USD 65.00. By the time when there was no more available wood in Minas Gerais State, industries had to search for supplies in Mato Grosso, Pará States and even imported wood from Uruguay and Argentina just to produce charcoal (INEE, 2007).

Social and technology aspects

Many times, charcoal production is associated with inhuman work conditions such as slavery, unfair labour practice and child labor exploitation. Job contracts are typically temporary and workers do not have social welfare warranties (MONTEIRO, 2005). Although true in many cases, these conditions can be avoided and in several cases labor legislation is observed. In these situations, charcoal production takes place under legal conditions, demonstrating that negative working condition is not always an intrinsic or inevitable consequence of charcoal making.

There is no official estimate of the actual number of jobs provided by charcoal production. If a charcoal worker produces 50 tons per year, charcoal production provides employment to about 110 thousand people in Brazil in 2005. Wage rates of the workers directly involved on the charcoal production are between US$ 52 and US$ 113 per month. This means working hard for more than eight hours work per day. Commercial charcoal trade thus provides employment and income opportunities to thousands of people, particularly in depressed areas of Brazil like Vale do Jequitinhonha, one of poorest regions of Minas Gerais State.

The charcoal production technique in Brazil remains crude and primitive. The technology is still the same as one century ago. Operating the kiln is very simple and usually there is neither qualitative nor quantitative production control, Moreover, the current technology discards tons of valuable chemical components as gas emission, (although some companies manage to recover these gases). This is so since in the carbonization process, 30 to 40% of wood dry mass is transformed into charcoal the rest is released to the atmosphere. Gases from wood carbonization contain more than a hundred organic chemical components, including fuel gases, acetic acid, methanol and tar (BRITO, 1990).

Fuelwood carbonization takes place in a traditional way at masonry kilns with cycles of heating and cooling that last for many days. At present, the rectangular kilns equipped with systems of steam condensation and tar recuperators are the most advanced being used in the country. However, the kilns with small production capacity, without mechanization and without systems of tar recuperation, known as *rabo-quente*, shown in Figure 9, continue to be the most used charcoal kilns. They are constructed with ordinary bricks and have roughly a semi-spherical form. The temperature of carbonization is approximately 500ºC. The carbonization operation consists of filling the kilns through the doors with dry wood, closing the kiln completely, leaving a small hole on the top to make the ignition and a several other small holes on the floor level to allow air entrance. The completion of the carbonization process is indicated by the changing of the color of the smoke through the chimney. When this occurs, all the small holes are closed and the oven is left to cool for approximately three days.

A typical charcoal kiln is a battery composed by six kilns. This number is related to the carbonization cycle process, which lasts for a duration of six days. The procedure is such that one day is allotted to fill the kiln, another day and two nights for the carbonization process to take place, two days for the cooling and one day for the discharging. This way, each day, there is at least one kiln to be loaded with wood, another to be discharged with the semi-finished products and four ovens to allow the carbonization process.

The productivity of the charcoal production is affected by the operation conditions, kiln project and wood humidity. On average, it can produce 165 kg of charcoal per cubic meter of fuelwood, using primitive techniques and operating the ovens according to intuitive procedures. On the other hand, modern methods are able to increase yields to approximately 200 kg of charcoal per cubic meter of fuelwood (NOGUEIRA; LORA, 2003). There are only few known studies and researches being conducted to improve and to increase the efficiency of these equipment, which are going to be valuable sources of knowledge in order to achieve sustainability in charcoal production.

Figure 9. ***Rabo-quente*** **kilns for charcoal production**

Charcoal and climate change issues

Within the context of steel munafacturing, there are two raw materials used in the process that has carbon dioxide emission implications: Coal and charcoal. Coal is used to produce coke in steel production and charcoal is used for pig iron production in steel mills. As such, each ton of steel produced is equivalent to 16.4 tons of carbon dioxide sequestered when charcoal is used; and 16.4 tons of carbon dioxide is added to the atmosphere if coal is used in the production process (Campos, 2002). These are the reasons why proposals to qualify charcoal producing activities for carbon credits have been put forward (ECOSECURITIES, 2002).

Under the Clean Development Mechanism (CDM) incentives, charcoal-based pig iron production will allow a project entity to curb wood supply deficit and eventually become self-sufficient. As the project plantations mature, the project entity can become self-sufficient in the supply of charcoal. The Minas Gerais State experience in establishing plantations is a case in point. The Minas Gerais project activity is expected to result in twofold benefits: (a) generation of carbon stocks and GHG removals by sinks that would have occured in the absence of such plantations and (b) substitution of sustainable sources of biomass in place of fossil fuels and non-renewable biomass, which contribute to GHG emissions in the iron and steel industry.

The Afforestation/Reforestation – A/R Clean Development Mechanism - CDM project activity, exclusively focuses on the generation of net anthropogenic GHG removals by sinks through establishment of additional plantations. The charcoal produced from the plantations established in the A/R activity will be used in the pig iron production so as to limit GHG emissions by substituting renewable sources of biomass in place of fossil fuels and non-renewable biomass. Within the A/R activity, eucalyptus plantations will be established and land use is for at least a 21-year period, with the first harvest taking place after 6 to 7 years, followed by two successive periods of 5 to 7 years rotations through coppicing. This kind of project adopts a single 30-year crediting period and uses the temporary Certified Emission Reductions - tCER approach to account for the net anthropogenic GHG removals by sinks from the project.

CONCLUSION AND RECOMMENDATIONS

The charcoal crisis in Brazil presents an excellent opportunity for the country to review and pay serious attention to the use of wood as energy resource. It appears paradoxical how such relevant bioenergy is absent in the energy policy of Brazil. This is a matter of fundamental requirement for a country where 13% of its TPES comes from wood energy. Wood energy has become equally as important to hydropower which also accounts for the other 13% in TPES.

In Brazil, charcoal is a highly valuable resource and contributes much to its economy particularly in the pig-iron and steel manufacturing industry. At present however, there is dearth of information vis-à-vis charcoal-related policies/guidelines. As such, policies need to be formulated and guidelines have to be developed along these lines. There is a sense of urgency and importance particularly given the issues and problems of sustainability of the supply and production of charcoal. There are other environmental implications as well i.e. conservation and protection of forest resources, among others. A desirable forest policy that can be formulated is one that will promote the expansion of forest areas, apply the use of modern technologies, and cultivate improved forest management strategies in Brazil. It should be one that encourages the use of better charcoal technologies (i.e. recovery of by-products, reduction of emissions, etc.).

Aside from policy formulation, research and database management likewise needs to be formalized and developed for planning and documentation purposes. There is an immediate need to come up basic supply and demand balances, market studies, origins of charcoal production and identification of areas under stress, and studies pertaining to combustion efficiency, and many more.

In terms of regulation and enforcement, the forest recovery capacity for charcoal production has been studied for a long time. Forest recuperation was observed after 8 to 10 years of cutting without fire techniques in some Brazilian regions. This practice could be more pronounced in charcoal production areas where there is no speculation for agricultural expansion. On the other hand, Forest Zoning is another alternative. This can assure sustainable management, conserve important forested areas and thereby protecting the environment.

CDM Projects in charcoal production

The Plantar project consists of the maintenance of charcoal-based production of pig iron in its mills in Minas Gerais, Brazil, funded through the sale of carbon credits. This is the first investment of the World Bank PCF in Brazil, who retained EcoSecurities to determine the potential GHG emission reductions to be generated by the project. The project involves the planting of over 23 000 ha with sustainably managed (certified to the Forest Stewardship Council standards) forests of high yielding clonal *Eucalyptus* trees. Additionally, Plantar will initiate a pilot project of landscape-scale management of biodiversity based on the regeneration of native vegetation in an area previously covered with plantation forests. It was estimated that the project has the capacity to generate 12 million tonnes of CO2 emission reduction equivalents over a 28-year timeframe. The PCF is particularly interested on replicating this investment and its effect on the iron & steel sector as a whole. The project is currently being independently verified by DNV, prior to completion of the deal. EcoSecurities is also assisting other companies on similar initiatives. One of them is being developed by V&M Tubes do Brazil (a joint venture between the French group Vallourec and the German company Mannesmannrohren-Werke). V&M Tubes is the only steel pipe manufacturer in the world to use 100% renewable energy for the production of pig iron and steel. Its forestry division, V&M Florestal, is responsible for the production of all charcoal required by its mills, from its 120 000 hectares of plantation forests (certified as sustainably managed according to the standards of the Forest Stewardship Council). The project consists of investments to ensure the use of sustainably-produced charcoal for steel manufacture in Brazil, avoiding the use of coke from coal. It is estimated that this will result in the reduction of 45 million tonnes of CO2 emissions during the next 27 years.

To reduce the illegal deforestation in Brazil, actions have been done e.g. broader surveillance; launching projects that combat corruption and illegal logging, management of land ownership, and the creation of protected areas. This set of measures intends to reduce fraud, bribery and illegal logging. However, these will require enabled personnel and and proper legal basis for enforcement.

Although all the production chain of charcoal is formed by private initiative agents, it is important to launch initiatives and signals from the government on the regulatory, economic and fiscal fields, consolidated in a policy towards sound development of woodfuel and charcoal production and use, with some clear guidelines:

- Identify long-term production targets and timetables aimed at increasing supply and reducing costs of wood used for energy purposes such as charcoal;
- Create an organization, preferably at the regional level, that will be responsible for the establishment of a National Wood Energy Information System. This organization will be tasked to develop consistent methodologies, conduct of surveys, sourcing of funds and resources, information dissemination, and the preparation of annual wood balance report. It should also identify the “hot spots” where charcoal is unsustainable and deserves more attention.
- Define norms and standards on wood energy systems preferably similar to “Certification” techniques and methods. These standards and certifications should be aimed at promoting efficiency, reducing losses, increasing sustainability, and recovery of gas by-products in the charcoal making processes.
- Develop conditions for forestry-related scientific and technological development i.e. forestry and wood energy processes, and expertise in production, conversion and management of wood energy systems.
- Enforce regulations not only in transportation of charcoal but also in its final use.

Charcoal is a renewable source of energy and an important feedstock for steel production in Brazil. Energy-related and forestry-related policies need be seriously considered to assure long-term production and sustainability and improve social and environmental conditions. In the final analysis, let it be known that it is still possible to produce competitive charcoal with good efficiency and in the process, preserves natural resources and respects workers rights.

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4. Analysis of fuelwood production systems in Guyana

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INTRODUCTION

In 1999, it was estimated that 1.9 billion m^3 of wood was burned for cooking to provide heat or to manufacture charcoal for later burning (FAO, 1999). Globally, there is a marked trend for developed countries to have a high per capita usage of energy as a whole, of which wood is a minor component, compared with developing countries with a low per capita energy input but a high proportion consisting of woodfuel (fuelwood and charcoal). Global fuelwood consumption is dominated by Asia and Africa (> 75% total volume production) with South America ranking third at 10%. Five countries: China, India, Indonesia, Nigeria and Brazil, account for about half the fuelwood and charcoal produced and consumed each year (Matthews, 2000).

High fossil fuel prices together with new energy and environmental policies are making woodfuel an essential ingredient of energy policy in both developed and developing countries. In developing countries, wood is already the primary source of energy for heating and cooking: in Africa, almost 90 percent of all wood removals are used for energy. With ever higher fuel prices, there will be even more pressure on forests and trees outside forests to provide energy in the poorest countries (FAO, 2007). Unfortunately, analyses of woodfuel consumption are complicated by a dearth of current, comprehensive data. The FAO woodfuel data, for example, are based largely on estimates derived from scattered 1960s household consumption surveys, which are updated annually in line with population and income growth. These estimates substitute for information on actual woodfuel consumption in most developing countries (Matthews, 2000).

In poor rural areas of developing countries, fuelwood is usually obtained directly by felling trees or collecting fallen wood. International trade in woodfuels is expected to increase in some regions, including Central and South America. Woodfuel production and export could become key ingredients for the development and expansion of forest activities, although it is not likely that this trend will have a direct impact on poverty. However, these activities may contribute to deforestation and forest degradation if policies are not implemented to avoid negative impacts.

In global terms, Guyana, with its small population (< 1 million), tropical climate and readily available fossil fuels for cooking, is not a major producer or consumer of firewood. However, the production, transport, sale and use of fuelwood do constitute a small but locally significant source of energy and income. Furthermore, despite the country's high forest cover (> 75%), the source of the wood raw material and the production units are rather localized along the main road transport arteries in the near interior. It is therefore critical to assess the sustainability of the current fuelwood production cycles and develop long-term policies to mitigate any negative impacts. The environmental and socioeconomic impacts of fuelwood production are intertwined and this study uses published statistics and reports, where available, on fuelwood to provide a baseline from which further work can provide more in-depth information to identify issues related to fuelwood production.

OBJECTIVES

The specific objectives of this study are:

- To identify supply sources for fuelwood.
- To describe process units involved with fuelwood production and analyse production statistics.
- To identify and discuss the key environmental, socioeconomic, cultural, institutional and legal aspects associated with production of fuelwood.
- To make recommendations for future actions.

FIREWOOD PRODUCTION IN GUYANA

Production cycle and statistics

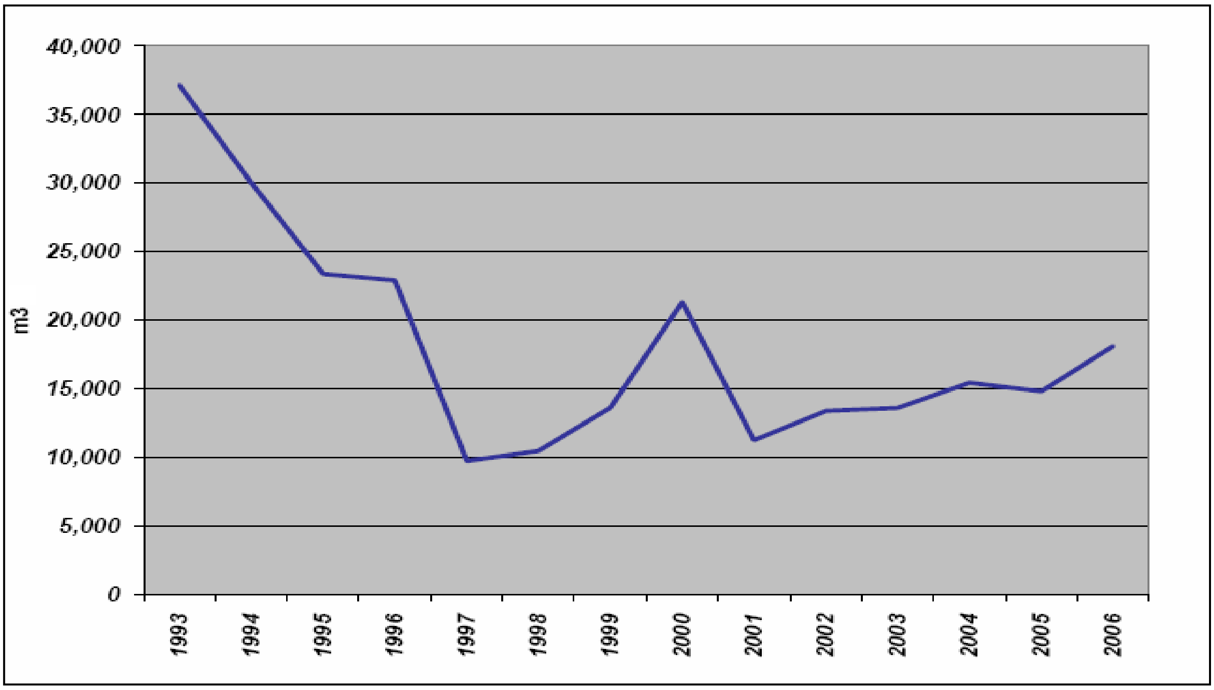
According to the GFC definition, woodfuel encompasses both fuelwood and charcoal and is "wood in the rough, from trunks and branches of trees, to be used as fuel for purposes such as cooking, heating and power production" (GFC, 2006). Fuelwood is classified as a raw material as no processing is involved and includes parts of trees made up into bundles or loads, or cut in a manner in which it is usual to cut wood for burning and all refuse wood generally, but does not include straight logs or poles of any kind (GFC, 1999; 2006).

Fuelwood becomes available from direct forest harvesting, timber industry waste, slash and burn operations associated with land clearing for agriculture and from self-gathering (GoG, 2002). Fuelwood is collected for personal use and for commercial purposes. In the latter case, wood is cut from the forest, typically of Wallaba (*Eperua spp*.) or Dakama (*Dimporphandra conjugata*) and then further cut into lengths (typically 4') after all the stems and branches are removed. These fuelwood billets are then loaded onto a truck and removed for sale.

Fuelwood was a large industry three decades ago when fossil fuels were in short supply and, even though volume production is much less now, it remains an important item. Although nationally it only accounts for 7% of energy usage, its share as a consumer good is larger, since the 67% share of petroleum and 26% bagasse (a by-product of sugar production) are industrial forms of energy. Industries like sugar refining and mining account for 90% of primary energy usage. A few timber enterprises generate power from wood waste but many sawmills do not have a ready market for firewood and simply dump off-cut wood (Hunter, 2002).

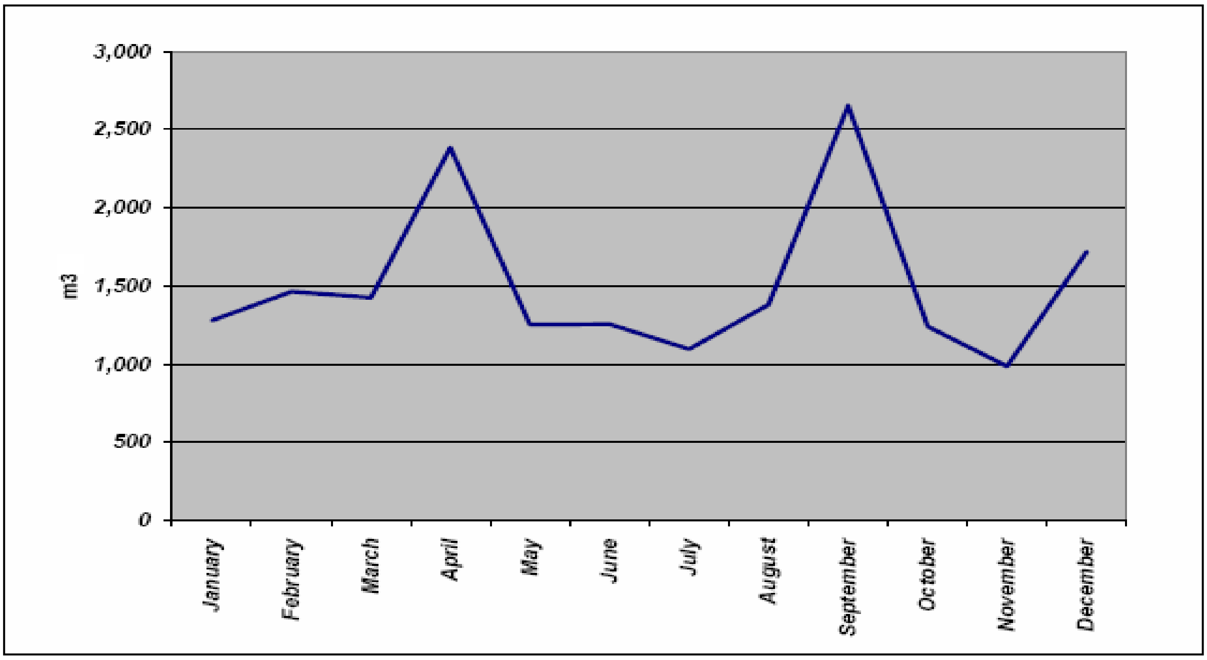
In 2006, approximately 18 000 m^3 of fuelwood for commercial purposes was recorded by the GFC. Fuelwood for personal use does not require to be declared and it is almost certain that some fuelwood collections go unrecorded. The commercial volume represented a 22.2% increase on 2005 (14 823 m^3) and is the highest production for the past six years (GFC, 2006) though it is only half the production of 1993 (Figure 1). Firewood production in Guyana peaked in 1980 when 40 000 tonnes were recorded (approximately the same in m^3 assuming the majority was wallaba and was weighed between green and air-dry condition). Production in 2006 was evenly distributed between the first and second semesters of 2006, with clear peaks during the main dry seasons (Figure 2). Fuelwood production continues to represent a small portion of total primary timber production. For example, in the fourth quarter 1997 it accounted for 1.3%; in 1998 it grew to 4.5% (in the fourth quarter) but by 1999 (in the fourth quarter) it had fallen 3.5 % (GFC, 1999). By 2006, fuelwood volume as a proportion of total timber production was at approximately this latter level.

Figure 1. Firewood production in Guyana



Sources: 1993-2002. GFC Market Report 2003: 2003-2006, GFC pers. comm.

Figure 2. Monthly firewood production in 2006



Source: GFC pers. comm.

Figure 3. Map of Guyana showing main roads (thicker line denotes metalled surface), Wallaba and Dakama forest (green) and key settlements.

Source: Map produced by G Clarke – roads and vegetation data courtesy GFC.

Location of Raw Material and Production Units

Fuelwood collection is concentrated in the white sand forests of the near interior and, especially for domestic use, the coastal mangrove forests. Soesdyke forest station was the main source of fuelwood reported in 2006, with 13 188 m^3 (72.8%), followed by Supernaam with 4 416 m^3 (Table 1). In both 2005 and 2006, nine fuelwood dealer licences were issued (four in Essequibo, two in Berbice, one on the East Coast Demerara, one on the East Bank Demerara and one in Georgetown [GFC, pers. comm.]). Most commercial cutting is done by persons who sell on to dealers. The majority of the cutting is done on private lands, agricultural leases and state forest permissions.

Table 1. Firewood production recorded by forest station, 2006

Station	2006 Firewood Production (m^3)			
(by period)	Jan-Jun	July-Sept	Oct-Dec	Total
Georgetown	21		0.00	21
Linden	410		29.00	439
Mabura	0.00		0.00	0.00
Soesdyke	6,506	33,805	2,875	13,188
Parika	50.75	0.00	0.00	51
Supernaam	2,061	1,318	1,035.97	4,416

Sources: GFC, pers. comm.

Fuelwood markets

The vast majority of fuelwood cut in Guyana is for consumption within Guyana. Commercial fuelwood is mainly consumed in steam boilers used on the sugar estates (GFC, 1999). Lesser amounts are used by bakeries and for the purposes of cremation. Fuelwood is used for cooking though this is concentrated in rural areas and is mainly derived from personal, non-commercial cutting. Given Guyana's tropical climate, wood is not required for domestic heating purposes. The small amount of fuelwood exported in 2005 and 2006 went to islands in the Caribbean (**Table 2**)

Table 2. Fuelwood exports: years 2005– 2006

Region/Country	**2005** (m3)	**2006** (m3)
St Vincent & the Grenadines	10.15	37.68
Total	38.58	37.68

Regulatory requirements

Licences are required on annual basis for fuelwood dealers. These licences are available at the GFC headquarters and from the main satellite forest stations. The following documents must accompany the application for a fuelwood dealer's license:

- proof of ownership of the land lease, tenancy agreement, concession agreement etc.,
- no objection letter from Central Housing & Planning Authority,
- no objection letter from the Environmental Protection Agency,
- permission letter from the Town Council or Neighbourhood Democratic Council or Regional Democratic Council,
- public Health & Safety Certificate and
- in the case of an individual applicant, national identification number, or for a company, certificate of registration or articles of association.

The majority of persons cutting fuelwood are people who are owners of agricultural lands or private lands so they do not directly fall under the jurisdiction of the Guyana Forestry Commission. However, when the produce is removed, a removal permit is required from the GFC. Persons are advised, if they are doing this on a regular basis, to apply for a SFP for state forest land.

ANALYSIS OF KEY ASPECTS

Socioeconomic, cultural and environmental

Firewood is sold at around US$20/$m^3$ and royalty is charged at G$30.35/$m^3$ (equivalent to US$0.15/$m^3$). Total royalty income is very small and, between 1999 and 2003, only exceeded US$ 2 000/year once (Table 3).

Table 3. Royalty income from fuelwood, US$ equivalent

YEAR	ROYALTY (US$)
1999	1 505
2000	1 595
2001	1 705
2002	2 035
2003	1 905

Source: GFC pers. comm.

There are no figures available for employment specifically in the commercial fuelwood sector (the GFC figure of 4 369 in 2006 for the “other” forestry sub-sectors include activities in furniture, building components, craft, utensils/ornaments, fuelwood, charcoal and conservation).

According to Hunter (2002), the re-growth (secondary) forest along the Linden Highway is a relic of fuelwood's day in the sun during the seventies and eighties. This is only partially true, as fuelwood exploitation of these most accessible areas has been going on for a century and still continues. Recurrent fires are a feature of these degraded white sand forests which contribute to their inability to fully recover to what can be assumed to be their natural condition.

The main species of these forests is Soft Wallaba (*Eperua falcata*) though Dakama (*Dimorphandra conjugata*) is dominant at early pioneering stages following severe disturbances such as repeated logging, land clearing for agriculture, fires (caused by nature or man) and woodfuel cutting for fuelwood or charcoal. The white sand forests represent a globally unique ecosystem and are especially vulnerable to overuse because they are located immediately inland from the coast, where most of the population resides, they are easily accessed via the main highway system (GoG, 2001) and exist on excessively drained soils with very low nutrient content.

Mangrove forests make up a belt of up to 80 000 ha, mostly along the North-western Atlantic coast and have traditionally been exploited for fuelwood and for bark tanning. The mangrove forest is important for the local economy and for customary uses. On the socioeconomic front, mangroves are used as a fuel source, fulfilling the requirement of many rural households. The Mangrove Forest type (*Rhizophora mangle* and *Avicenia nitida*) of the marine ecosystem provides protection to the shoreline against marine erosion. The mangrove is also a rich source of fauna species that has great potential to generate revenue through tourist activities, etc.

The most important effect on the mangrove fringe at present is the practice of cutting for fuelwood. This occurs in all areas and is carried out both on an artisan and commercial scale. The removal of the mangrove results in risks for the sediment stabilization, shoreline anchoring, flood control, production and food chain support, wildlife habitat, fisheries, fuelwood, etc. The vulnerability and risk of the biological diversity of mangrove resources is also highly critical for fishes and sea turtles.

Legal and institutional

Fuelwood is recognized as a bona fide forest produce in the Forests Act (1953). However, it is not subject to any specific regulation beyond declaration of removal and payment of royalties. The draft regulations of 2005 state that the holder of a timber concession may cut and use within the concession area such timber as may be required for the construction of stellings, ramps, roads, bridges, buildings and tramways, or as fuelwood. Fuelwood is not specifically mentioned in the Poverty Reduction Strategy Paper, the Draft Forest Policy (1997) or the National Forest Plan (2001).

CONCLUSIONS AND RECOMMENDATIONS

Status and impact of firewood production in Guyana

Commercial fuelwood production remains a small sub-sector of the forest industry in Guyana, accounting for around 3.5% of total timber production by volume in 2006 (and negligible export earnings). Nevertheless, from the limited statistics available, fuelwood production does appear to have local socioeconomic significance, especially in rural areas where alternative livelihoods are limited. The environmental impact of current levels of fuelwood production is difficult to quantify though it is widely acknowledged that, over the decades, the sub-sector has contributed to the degradation of certain forest types. Since these forests are typically relatively fragile, have wider ecological value and are generally quite accessible, the proportionate impact may be quite significant.

Topics for further in-depth studies

There is a need for further baseline studies on the current socioeconomic and environmental status of fuelwood production in Guyana. Important questions that need to be addressed are the exact location of raw material sources, the amount of fuelwood cut for private domestic purposes, environmental impacts of current production levels and regeneration of the white sand forests and mangroves after exploitation, importance and value of fuelwood production to local communities and individual livelihoods and costs and revenue associated with a typical fuelwood operation. Though fuelwood does not currently play a major part in the security or economy of Guyana, thought could be given to drafting a fuelwood energy policy which would consider, as suggested by FAO (1987), the present size and characteristics of the wood resource and its future development, the present consumption pattern of fuelwood and charcoal and probable future development, how the present supply is produced and distributed and what the possibilities are for its rationalization and improvement. The policy framework could lay the foundations for a national management plan for fuelwood production.

Specifically for the white sand forest areas, as recommended by the Climate Change Action Plan (2001), possible actions could include exploring the possibilities of establishing reserve areas for the conservation of this unique ecosystem and at the same time safeguard the water supply, the rehabilitation of the forest cover and recovery of site productivity and development of a plan for forest fire protection. A similar approach could be taken towards mangrove forests in conjunction with the existing national mangrove management plan (GFC, 2001b). Possible actions for the mangrove forest are mapping the resource, reforestation and protection of the mangrove forest under the Integrated Coastal Zone Management, alternative sources of fuelwood and replanting programmes and the involvement of the communities themselves in the sustainable management of the resource (GoG, 1997; 2001). The NDS recognizes the importance of mangrove ecosystems and states that operations in the coastal mangrove areas will be carefully monitored and felling in these ecosystems absolutely banned.

In the medium term, subsequent to further baseline studies and development of a policy and plan, criteria and indicators for fuelwood production areas should be developed along with protocols for monitoring and feedback.

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5. Analysis of charcoal production systems in Guyana

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INTRODUCTION

It is estimated that approximately 1.5 billion people in developing countries derive at least 90% of their energy requirements from wood and charcoal. Another one billion people meet at least 50% of their energy needs this way. In most developing countries, 90% of the people depend on fuelwood as their chief source of fuel and each year the average user burns anywhere from a fifth of a ton, in extremely poor, wood short areas such as India, to well over a ton in parts of Africa and South Asia (GFC, undated).

In 1999, it was estimated that 1.9 billion m³ of wood was burned for cooking, to provide heat or to manufacture charcoal for later burning (FAO, 1999). Globally, there is a marked trend for developed countries to have a high per capita usage of energy as a whole, of which wood is a minor component compared with developing countries with a low per capita energy input but a high proportion consisting of fuelwood (firewood and charcoal).

Global fuelwood consumption is dominated by Asia and Africa (> 75% of total volume) with South America ranking third at 10%. Five countries: China, India, Indonesia, Nigeria and Brazil, account for about half the fuelwood and charcoal produced and consumed each year (Matthews, 2000).

Unfortunately, analyses of woodfuel consumption are complicated by a dearth of current, comprehensive data. The FAO woodfuel data, for example, are based largely on estimates derived from scattered 1960s household consumption surveys, which are updated annually in line with population and income growth. These estimates substitute for information on actual woodfuel consumption in most developing countries (Matthews, 2000).

In global terms, Guyana, with its small population (< 1 million), tropical climate and readily available fossil fuels for cooking, is not a major producer or consumer of charcoal. However, the production, transport and combustion of charcoal do constitute a small but locally significant source of energy and income. Furthermore, despite the country's high forest cover (>75%), the source of the wood raw material and the production units are rather localized along the main road transport arteries in the near interior.

It is therefore critical to assess the sustainability of the current charcoal production cycles and develop long-term policies to mitigate any negative impacts. The environmental and socioeconomic impacts of charcoal production are intertwined and this study uses published statistics on charcoal production and use to provide a baseline from which further work can provide more in-depth information to identify issues related to charcoal production.

OBJECTIVES

The specific objectives of this preliminary desk based study are:

- To identify supply sources for charcoal.
- To describe process units involved with charcoal production and analyse production statistics.
- To identify and discuss the key environmental, socioeconomic, cultural, institutional and legal aspects associated with production of charcoal.
- To make recommendations to future actions.

BACKGROUND

Charcoal is an alternative energy source which has been produced in Guyana for a number of decades and for periods in the latter half of the 20^{th} century, was a significant local industry that also supplied a substantial export demand. A general period of decline in the industry followed the increase in availability and use of alternative fuels (especially kerosene and liquid petroleum gas for cooking) though there has been recent upsurge in production to feed a small but important export market and a reliable local demand primarily for domestic and commercial barbeque use. In the pre-independence period exports of charcoal form British Guiana were primarily to the United Kingdom. Currently, however, exports are almost exclusively destined for Caribbean countries.

Charcoal production methods in Guyana have traditionally utilised simple technologies and the pit method of production is still the most prevalent. Readily available tree species is found on the white sand forest types that are common in the accessible near interior areas. Charcoal production has therefore contributed to large areas of degraded forests, especially along the main road arteries for some 100 miles south of the capital Georgetown.

CHARCOAL PRODUCTION IN GUYANA

Production cycle

Charcoal is the solid residue remaining when wood is carbonized under controlled conditions in a closed space (FAO, 1987). Control is exercised over the entry of air during the carbonization process so that the wood does not burn away to ashes, as in a conventional fire, but decomposes chemically to form charcoal. The pyrolysis process, once started, continues by itself and gives off considerable heat. However, this pyrolysis, or thermal decomposition of the cellulose and lignin of which the wood is composed, does not start until the wood is raised to a temperature of about 300° Celsius.

In traditional methods of production, some of the wood loaded into the kiln is burned to dry the wood and raise the temperature of the whole of the wood charge, so that pyrolysis starts and continues to completion by itself. The wood burned in this way is lost. All carbonizing systems give higher efficiency when fed with dry wood, since removal of water from wood needs large inputs of heat energy.

The pyrolysis process produces charcoal which consists mainly of carbon, together with a small amount of tarry residues, the ash contained in the original wood, combustible gases, a number of chemicals mainly acetic acid and methanol and a large amount of water which is given off as vapour from the drying and pyrolytic decomposition of the wood. When pyrolysis is completed the charcoal, having arrived at a temperature of about 500° Celsius, is allowed to cool down without access of air; it is then safe to unload and is ready for use.

There are two main methods used in the production of charcoal: the pit tumulus method and the portable kiln method. The pit method involves digging a pit of various sizes, stacking the wood and burning under conditions of restricted oxygen. It is the most prevalent method in use in Guyana.

The pit (typically 3m long by 1.2m wide and 1.2m deep) is loaded with lengths of small round-wood logs which will fit easily across the pit. When the pit is full, an airtight layer of leaves and then earth is placed on top. To ensure that the wood is properly heated for carbonization, the hot gas is allowed to pass along the floor of the pit, beneath the charge, by placing the charge on a crib of logs. The hot gases, produced by partial burning at one end of the pit, travel to the flue at the opposite end. These hot gases slowly dry out the earth and heat up the rest of the wood to the carbonization initiation point, about 280300°C.

Depending on the size of the pit and the species used, a batch of charcoal takes approximately 14 weeks to produce. The nature of carbonization in a pit makes it difficult to achieve a uniformly carbonized charge. The charcoal at the firing end is normally low in volatiles and the last formed charcoal near the smoke flue is high in volatiles, since it was subjected to carbonizing temperatures for only a short time.

The pit method has several advantages, namely: less initial investment; small production costs relative to the other methods; higher density (and better quality) charcoal and a relatively low level of fines produced.

The portable kiln method involves stacking small air-dried billets in a metal kiln, covering and burning. The main advantages of transportable metal kilns compared with the traditional earth pit are:

- raw material and product are in a sealed container giving maximum control of air supply and gas flows during the carbonization process,
- unskilled personnel can be trained quickly and easily to operate these units and less supervision of the process is required compared to the constant attendance necessary with pits,
- mean conversion efficiencies of 24% including fines (dry weight basis) can be consistently achieved. Pits can give erratic, often lower yields,
- all of the charcoal produced in the process can be recovered. With pit methods some of the charcoal produced is lost in the ground and that which is recovered is often contaminated with earth and stones,
- transportable metal kilns, if designed to shed water from the cover, can be operated in areas of high rainfall, providing the site has adequate drainage. Traditional methods of charcoal production are difficult to operate in wet conditions and
- the total production cycle using metal kilns takes two to three days.

Location of raw material and production units in Guyana

Raw material collection and charcoal production are concentrated in what are now secondary forest areas accessible to the main population concentrations along the coast. Charcoal activities occur in significant quantities along the Soesdyke Linden Highway, the Ituni and Mabura Roads and the upper Berbice River.

Typically, the secondary forests are those that have been logged-out or high-graded over a period of years and whose restoration to high forest condition is prevented by continual exploitation and recurrent fires. Typically, these forest types occur on the white sands of the Berbice formation. These soils are typically excessively drained and very infertile. Dominant species and those used for charcoal production are Wallaba (*Eperua spp.)* and Dakama (*Dimorphandra conjugata*). Intensive exploitation combined with the soil conditions and fire can result in the development of degraded low forest and scrub vegetation.

Charcoal produces generally fall into one of the three main categories:

- farmers who are clearing their land convert some of the wood resources to charcoal,
- sawmillers and loggers who produce charcoal as part of their general operations and
- professional charcoal producers.

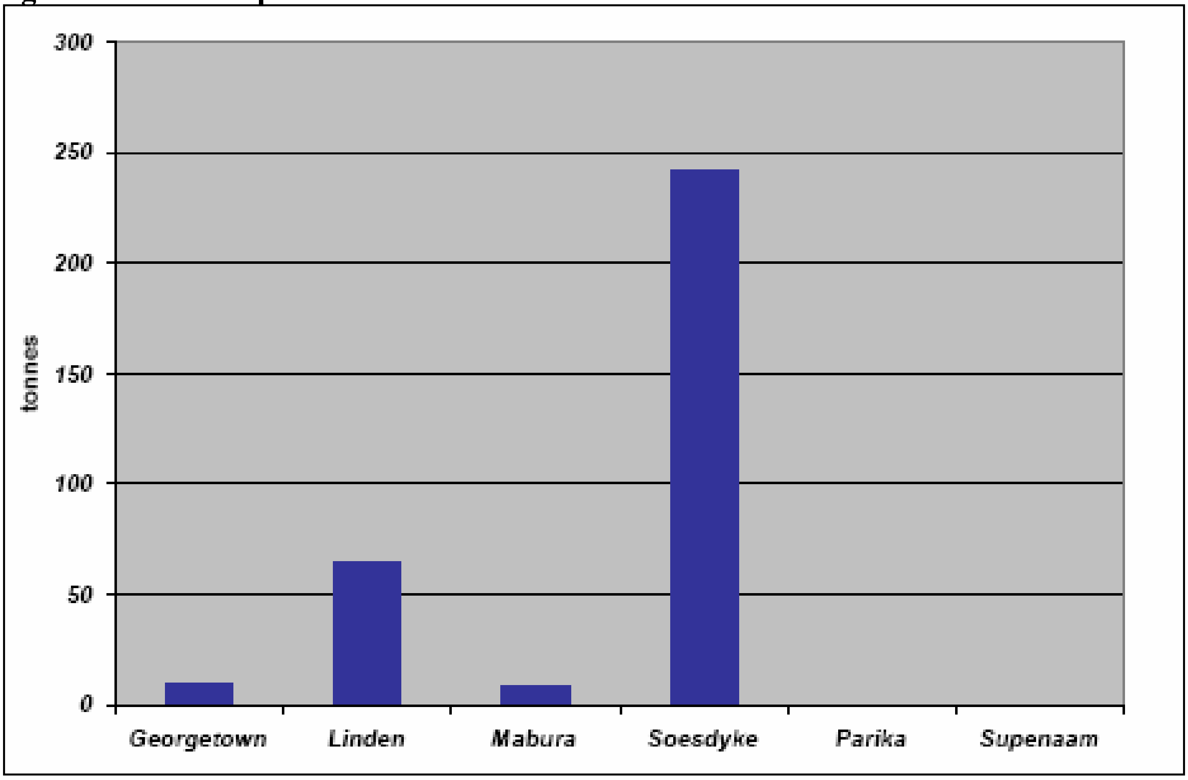
According to an internal GFC study conducted in the mid 1980s there were, at that time in Guyana, a total of 163 charcoal producers, 78% using the earth pit, 13% using a kiln and 9% using both methods (Table 1). Figures from 2002 indicate that there had been a dramatic drop to eleven charcoal producers at that time which fell again to just six by 2003 (Thomas, *et al,* 2003). In 2005, there were still six licensed producers (all within Demerara County) and in 2006 ten licensed producers (four in Georgetown, two on West Coast Demerara, two on the Linden Highway and two on East Bank Demerara; GFC pers. comm.). Of the total recorded production in 2006, the majority (75%) was recorded at Soesdyke forest station, with smaller amounts at Linden, Georgetown and Mabura (Figure 1).

Table 1. Charcoal production areas, number of producers & type of production

Area	# of producers (kiln)	# of producers (pit)	# of producers (both)	Total
East Coast Demerara	1	-	-	1
East Bank Demerara	1	-	-	1
Soesdyke Linden highway (Lower Dem R)	9	46	5	60
Soesdyke Linden highway (Upper Dem R)	-	23	3	26
Ituni Road	-	4	1	5
Wismar	-	5	-	5
Wismar Rockstone	3	25	4	32
Mabura Hill	2	2	2	6
Bartica Triangle	2	8	-	10
Essequibo Coast	1	11	-	12
North West District	1	1	-	2
Berbice River	1	2	-	3
Total	**21**	**127**	**15**	**163**

Source: undated GFC report, estimated mid-1980's

Figure 1. Charcoal production recorded at GFC forest stations in 2006



Source: undated GFC report

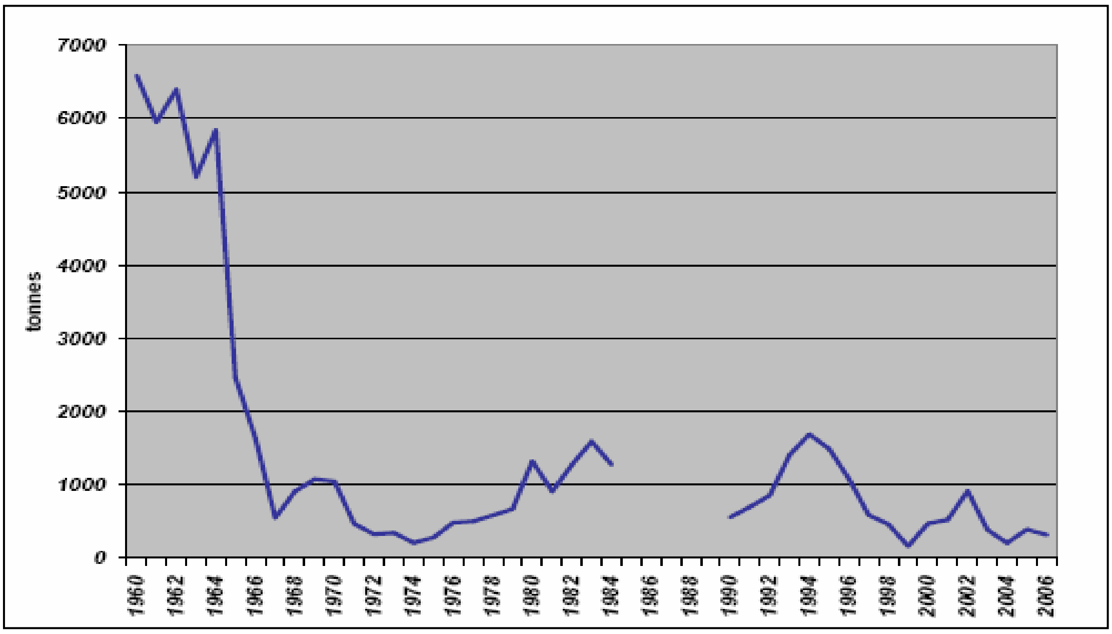
Production statistics

Production statistics are based on declarations made to the GFC. Unfortunately, there is not a complete annual record from 1960 to the present. However, from various sources (GFC undated report, GFC annual market summaries and GFC pers. comm.) data series from 1960–1984 and 1993–2006 have been compiled (Figure 2). Over the years between 1946 and 1964 production averaged about 6 600 tons annually (GFC, undated). This was a significant amount for relatively small producer country, but small (around 2%) in comparison with, for example, total world imports of charcoal (which in 1961 was 295 000 tons).

There followed a significant decline in production between the years 1965 and 1974 when production averaged about 980 tons. From 1974 to 1984 there was a small recovery though subsequently there was another decline. Following another brief recovery in 1994, over the period 1994 to 1998 charcoal production again declined steadily from 1 717 tonnes in 1994 to the 1998 level of 461 tonnes, which has been approximately equal to the average annual production over the last five years. In 2006 production fell 18.6% from the 2005 level, volume being 319 tonnes compared with 392 tonnes previously. Annual levels have fluctuated over the past four years and have not recovered to 2000–2002 levels.

The decline over the years has been attributed to shrinking export markets, a national strategy of de-emphasizing the industry (at least during the 1960s) and a reduction in domestic consumption following successful promotion of kerosene and, latterly, liquefied petroleum gas as fuel for cooking purposes.

Figure 2. Charcoal production in Guyana (tonnes equivalent: from 1960-1984, converted from imperial tons; 2004 converted from m^3 using GFC conversion of lm^3: 0.133t).



Sources: 1960-1984-GFC undated report: 1990-1993, GFC via GoG, 2002; 1994-2003 GFC Market Report 2003: 2004-2006 - GFC personal communication No data available between 1985-1989)

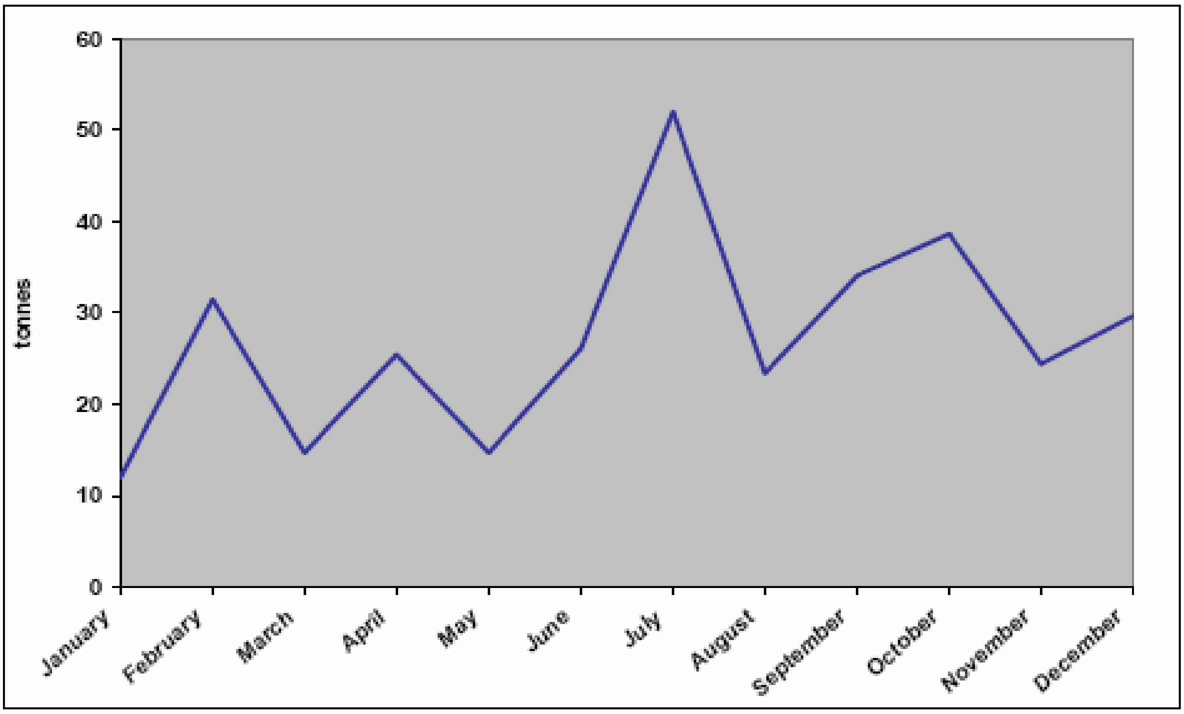
Within general trends, there are noticeable fluctuations between years. One possible reason for this is changes in weather patterns. The decline in 1998 (compared with 1997 figures) was attributed, in part, to the exceptionally hot weather in the third quarter of 1998 which made it difficult for charcoal pits to cool off in the usual length of time (GFC, 1999). There are also marked fluctuations in monthly production through individual years. For 2006, peak production occurred in July, October and February which may be a weather-related phenomenon as these months generally occur during the drier parts of the year (Figure 3).

Use of charcoal and charcoal markets

The principal primary sources of energy in Guyana are imported petroleum products, bagasse (a by-product of sugar production) and fuelwood. In 1992, they accounted for 48.7%, 25.9% and 25.4%, respectively, of the energy produced in the country (ITTO, 2003). From 1974–1984 there was a rise in domestic consumption of charcoal, though there is a gap in data until 1994 after which consumption dropped to around 600 tonnes (Figure 4). Though there are no figures available since 1998, it is believed that most charcoal dealers cater to the local market (primarily for domestic and commercial barbeques) though there are occasions for quantities to be exported, mainly to the Caribbean (Thomas *et al*., 2003*;* see also Table 2).

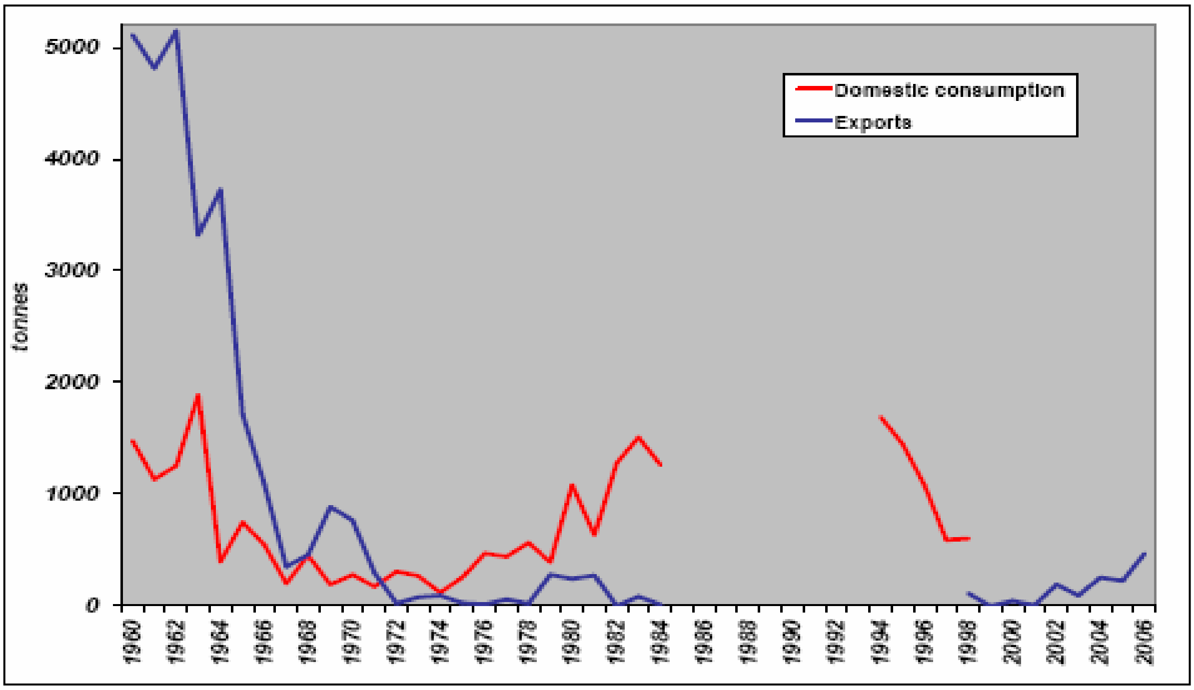
From the then British Guiana, in 1960 exports of charcoal amounted to 5 052 tonnes and had a value at the time of $248 133 and in 1961, 4 814 tonnes were exported at a value of $236 500 (Orescanin, undated). The United Kingdom was the main buyer. From then until 1970, there was a steady decline in exports and since that time until present in most years there was less than 300 tonnes exported, though in 2006 there was a rise to almost 470 tonnes.

Figure 3. Production by Month (2006) (data converted to tones from M^3)



Source : GFC pers. comm.

Figure 4. Domestic consumption and export (tones equivalent), 1960-1984; 1994-1998 & 1998-2006. No data 1985-1993; 1999.



Source: GFC, undated, Energy Agency and GFC market reports and pers. comm.

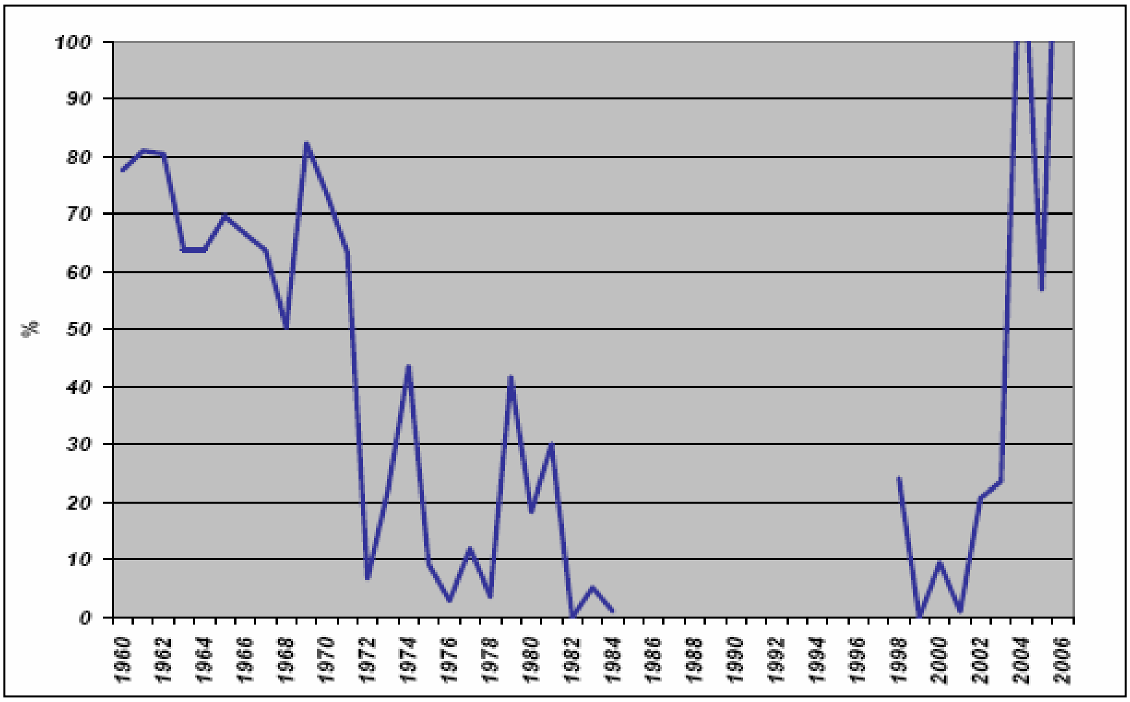
From 1960–1984, the proportion of charcoal production exported showed a general decline from around 80% to less than 10% (**Figure 5**). Recent figures suggest a potential rise in the proportion of exports, though there are small fluctuations (Note that the published export figures for 2004 and 2006 suggest a higher level of export than recorded production. The possible reasons for this anomaly are being investigated).

Table 2. Charcoal Exports for 2005-2006

Region/Country	2005 (m^3)	2006 (m^3)
Caribbean		
Antigua/Barbuda	-	15.54
Barbados	2.42	-
St Vincent and the Grenadines	103.64	-
Trinidad and Tobago	897.90	2257.89
British Virgin Islands	-	31.09
French West Indies	666.44	1045.99
Total Caribbean	1670.40	3350.51
Africa		
Togo	-	154.76
Total	**1670.40**	**3505.27**

Sources: GFC, pers. comm.; GFC, 2006

Figure 5. Exports proportion of total production: 1960-2003 (no data 1985-1997)



Sources: GFC undated report, GFC market reports (not that there is an anomaly for 2004 and 2006 when exports apparently exceeded recorded production

ANALYSIS OF KEY ASPECTS

Environmental

In the 19th century the Wallaba (*Eperua spp*.) forests of the white sandy plains behind the coastal belt began to be exploited intensively for fuelwood and charcoal, roofing shingles, fence posts and staves. This exploitation continues up to the present and has led to severe degradation of this forest type in the mid and lower Demerara River area. The National Development Strategy has recognized this and states that, in particular, development policies for the wallaba forests should take into account the vulnerability of that environment in relation to charcoal burning, sand mining and logging for timber and timber products.

The main species of these forests is Soft Wallaba (*Eperua falcata)* though Dakama (*Dimorphandra conjugate)* is dominant at early pioneering stages following severe disturbances such as repeated logging, land-clearing for agriculture, fires (caused by nature or man) and wood cutting for fuelwood and charcoal. The white-sand forests represent a globally unique ecosystem and are especially vulnerable to overuse because they are located immediately inland from the coast, where most of the population resides. They are easily accessed via the main highway system (GoG, 2001) and exist on excessively drained soils with very low nutrient content.

Socioeconomic and cultural

Estimates of total employment in the forest and wood product sector vary widely because of the composition of the industry and the nature of its employment. Firstly, the industry comprises formal and informal sectors. Secondly, employment in some areas of the industry is seasonal or sporadic in nature such as; the production of charcoal, shingles, joinery, wood and nibbi furniture, wooden crafts and the collection of latex and medicinal plants (ITTO, 2003). Nevertheless, estimates of employment in the charcoal industry in Guyana do exist for the period 1992–1997 (Table 3) and for the whole fuelwood sector, for 2001 (244 persons according to Hunter, 2002).

Table 3. Employment 1992-1997

Year	Number employed
1992	186
1993	234
1994	245
1995	225
1996	165
1997	180

Source: GFC, 1999

The NDS recognizes that micro-enterprises that produce lumber, millwork, lianas (nibbi and kuffa articles), crafts, charcoal and shingles are becoming a most significant source of income and employment.

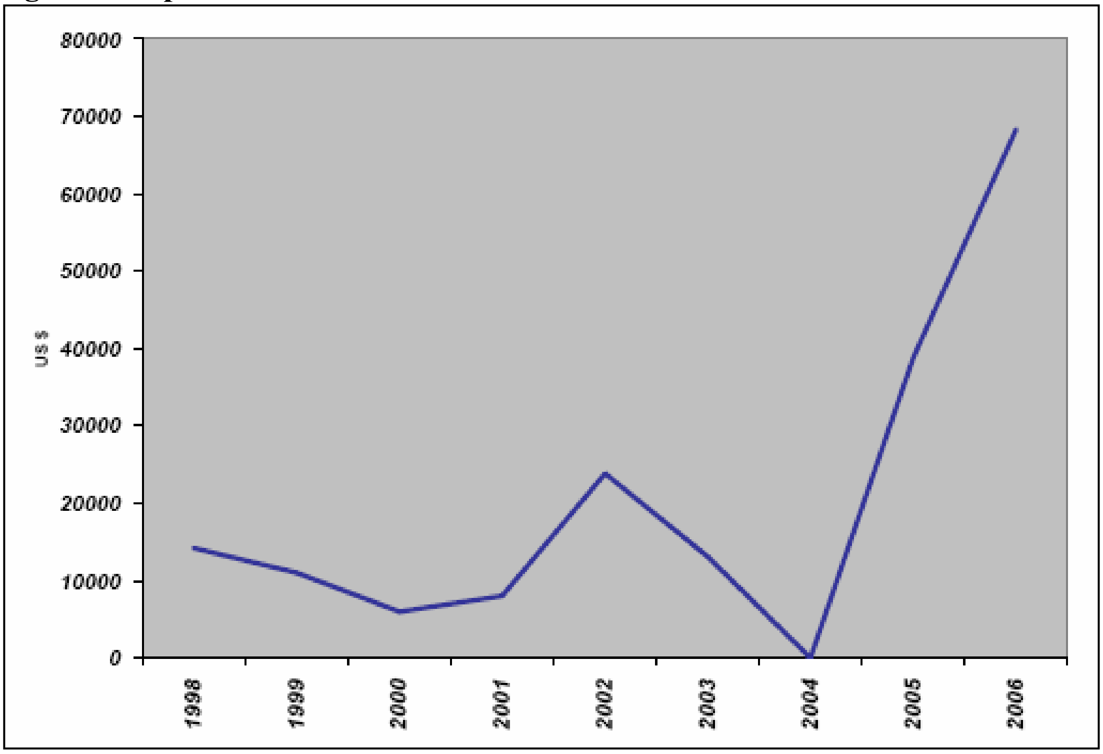
Royalty on charcoal is charged at G$1.32/kg which in the years between 1999 and 2003 yielded the modest amount of around US$5 000 for the period (Table 4). The value of exports is more impressive, reaching US$70 000 in 2006 (Figure 6).

Table 4. Royalties from Charcoal

Year	US$
1999	930
2000	1170
2001	1225
2002	1125
2003	825

Source: GFC market reports, US$ equivalent

Figure 6. Export value of charcoal 1998-2006



Source: GFC market reports: no figure for 2004

The forestry sector has been a beneficiary of loans from the Institute of Private Enterprise and Development (IPED). Between 1986 and 1999, IPED provided 73 loans or 0.4% of its loan portfolio to logging, sawmilling and charcoal producing groups/individuals. However, it has been noted that there is a reduction in borrowing from this institution by logging and sawmilling companies (Thomas *et al.,* 2003). The NDS recognizes a link between poverty and environment exists to some extent, despite the low population density, in Guyana and cites examples of cutting of trees for charcoal and the reaping of mangroves for household use.

Institutional and legal

In the 1953 Forests Act, "forest produce" is defined to include fuelwood and charcoal, though no other specific mention of charcoal is made in the Act. In the 1953 Forestry Regulations, it is stated that recognized "commercial" trees shall not be used for fuelwood or charcoal (though branches may be used for fuelwood) without permission of a forest officer. Also, charcoal removed must be accompanied by the appropriate paperwork (removal permit for State Forest; removal declaration from private lands).

The charcoal industry is not specifically mentioned in the National Forest Plan (2001), the Draft Forest Policy (1997) or the Guyana Poverty Reduction Strategy Paper. Timber dealers, sawmill, sawpit, charcoal and fuelwood producers are all required by law to obtain licences from the Guyana Forestry Commission before any operation can start. However, charcoal licences, at a modest cost of around US$15/year, are only needed when the producer has intent to sell on a large scale basis or for export. Most producers are persons who have agriculture lands and/or private lands and do not come under the regulations of the Guyana Forestry Commissions so they do not need licences for production or to sell. In some cases, when private persons are selling in large quantities, only removal permits are required. Application for licences can be made at any of GFC forest station location and must be accompanied by the following documents:

- proof of ownership of the land – lease, tenancy agreement, concession agreement, etc.,
- no-objection letter from Central Housing and Planning Authority,
- no-objection letter from the Environmental Protection Agency,
- permission letter from the Town Council or Neighbourhood Democratic Council or Regional Democratic Council,
- Public Health & Safety Certificate,
- in the case of an individual application – National Identification Number and
- Company Certificate of Registration.

As mentioned above, charcoal production is mainly done by persons having agricultural lands and/or private land and as such they are not operating illegally. However, the removal of the product without a permit is an offence and produce can be detained by the GFC once an offence is detected. In 2006, a total of 20 tonnes was detained (see Table 5) for one or more of the following reasons.

- The stakeholder did not possess the required permit to remove said forest produce.
- The person in charge did not deliver permit within 24 hrs of arrival at destination.
- Persons tried to evade payments of royalty.
- Persons failed to declare correctly whether produce was legally obtained and the correct quantity.
- Persons altered the documents issued.

Table 5. Quantity of illegal charcoal seized/detained in 2006 and related offences

Quantity (kg)	Offences
6,123.6	Illicit operations
1,632.96	Chapter 67:01 Sec 42 Reg. 3
1,814.37	Chapter 67:01 Sec 42 Reg.25
4,535.92	Chapter 67:01 Sec 22 (b) & (c)
902.18	Chapter 67:01 Sec 42 Reg. 20
4,354.48	Chapter 67:01 Sec 42 Reg. 25
290.30	Chapter 76:01 Sec 22 (1)
362.87	Chapter 67:01 Sec 42 Reg. 23

Source: GFC pers. comm. Guyana Forest Act, 1953

CONCLUSIONS AND RECOMMENDATIONS

Status and impact of charcoal production in Guyana

Charcoal production remains a very small sub-sector of the forest industry in Guyana, contributing in 2006 less than one-half percent of both total timber production and export earnings. Nevertheless, from the limited statistics available, charcoal production does appear to have local socioeconomic significance, especially in rural areas where alternative livelihoods are limited. The environmental impact of current levels of charcoal production is difficulty to quantify though it is widely acknowledged that, over the decades, the sub-sector has contributed to the degradation of certain forest types. Since these forests are typically relatively fragile, have wider ecological value and are generally quite accessible, the proportionate impact may be quite significant.

Topics for further in-depth studies

There is a need for further base-line studies on the current socioeconomic and environmental status of charcoal production in Guyana. Important questions that need to be addressed are the exact location of raw material sources; environmental impacts of current production levels and regeneration of the white sand forests after exploitation; importance and value of charcoal production to local communities and individual livelihoods, costs and revenue with a typical charcoal operation.

The very recent trend for charcoal exports suggests that there is potential for an expansion of the sub-sector to meet a potential market in the Caribbean and beyond. It has been recognized that a more developed charcoal industry in Guyana could benefit the public and private sector and the country as a whole in achieving some goals such as provisions of job opportunities, generation of suitable energy substitute, provisions of a suitable export product, provision of a chemical and fuel base for industries and increasing the total profitability of the forest by maximum utilization (Branche, undated). However, an expansion would need to be premised on an evaluation of the resource especially, its economic accessibility and sustainability. Though fuelwood does not currently play a major part in the security or economy of Guyana, thought could be given to drafting a fuelwood energy policy which would consider, as suggested by FAO (1987), the present size and characteristics of the wood resource and its future development; the present consumption pattern of fuelwood and charcoal and probable future development; how the present supply is produced and distributed and what the possibilities are for its rationalization and improvement. The policy framework could lay the foundations for a national management plan for fuelwood production.

Specifically for the white sand forest areas, as recommended by the Climate Change Action Plan (2001), possible actions could include exploring the feasibility of establishing reserve areas for the conversion of this unique ecosystem and at the same time safeguard the water supply; the rehabilitation of the forest cover and recovery of site productivity; development of a plan for forest fire protection.

In the medium term, subsequent to further baseline studies and development of a policy and plan, criteria and indicators for fuelwood production areas should be developed along with protocols for monitoring and feedback.

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6. The analysis of sustainable fuelwood and charcoal production systems in Nepal: A Case Study

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EXECUTIVE SUMMARY

Introduction

Energy is essential not only for survival but also for improvement of the quality of life of the Nepalese people. In this regard, the positive role of clean, affordable, indigenous and renewable sources of energy that could be produced and supplied on a sustainable basis would be significant in the development of this poor, least-developed country in South Asia. Currently, traditional biomass fuels contribute directly to the energy supply as well as in the livelihoods of great number of Nepalese people.

Virtually all people in rural areas relied on traditional biomass fuels, primarily fuelwood for meeting their domestic cooking and heating energy needs. Some of them were also depending on fuelwood for domestic lighting. For many of them, there was no choice but to continue the use of traditional fuels for domestic energy. Similarly, the urban poor could also not afford to use the imported commercial fuels for cooking and heating and had to rely on dried biomass, primarily fuelwood, for meeting their cooking energy needs. Therefore, majority of the Nepalese people have been using and will continue to use the dried biomass fuels for energy for many years to come.

This case study relied solely on secondary information available from different sources, i.e. published reports and documents of R&D and academic institutions, individual researchers, government forestry agencies including Department of Forests (DoF), Forest Products Development Board (FPDB), Timber Corporation of Nepal (TCN), etc. There was no collection of primary data for the purpose of this study.

Woodfuel production and supply systems

In Nepal, the most important woodfuel production sources included national forests under different types of management, under government forestry department, by forest users group (FUG) of local community forest (CF) or by lessee of leasehold forests, etc. Besides, private forests and trees on non-forest lands (TOF) also contribute to both traded and non-traded woodfuel supplies in many areas. The priority of any forest owner, manager or developer would therefore, be to dispose of their forest and tree products at a highest possible price in the market, be that product from private, community or public sources. So the Nepalese producers of traded woodfuel would be no exception to this universal marketing practice.

The present demand of woodfuel was primarily for traditional applications (for cooking and heating). The type of fuels used for these purposes was mainly fuelwood and a limited amount of charcoal, only for specific end uses. Most of the households self-collected the woodfuel they used for free at production sources. Some users might be using hired labour for collection but invariably without payment of stumpage fee or government royalty. Which means, a major share of the woodfuel consumed in the country therefore, did not pass through any formal or informal marketing channels.

Three institutions in the public sector, namely the District Forest Products Supply Committees (DFPSC) under Department of Forests (DoF), the Forest Products Development Board (FPDB) and the Timber Corporation of Nepal (TCN), both under Ministry of Forests and Soil Conservation (MFSC), were the key players in the production and supply of woodfuels in the markets. Currently, none of these institutions produce or sell charcoal in the country.

Currently, most of the fuelwood consumed in the country is by rural households and in traditional industries, which is totally a new scenario compared with the situation about two decades ago. Then, even the urban households depended on fuelwood for domestic cooking. However, in recent years the urban households have rapidly been switching over to alternative commercial energy, primarily LPG and kerosene for cooking and heating.

Mostly these households in newly emerging market places, alongside of newly built roads, small towns and district headquarters not yet connected with road seemed dependent on fuelwood for meeting their energy needs for cooking, heating and also for cooking cattle feed. The other end uses were heat application for agro and food processing. Some of the woodfuel used by these users were supplied through formal or informal marketing channels.

Applicability of certification in Nepal

In the recent past, two initiatives of forest certification were undertaken for the certification of important forest products of community forests, primarily for initiating sustainable management of community forests and for promoting the trade of forest products derived from CF for income generation to the local people in rural areas. It was reported that Nepal has developed specific set of criteria and indicators at the national level for the certification of community forestry and leasehold forestry management with the forest user groups under the guidance of Center for International Forestry Research (CIFOR). It was reported that these criteria and indicators are yet to be properly organized and applied in a systematic manner.

However, the term “forest certification” could not be viewed solely from the point of view of certification of specific forest products such as timber, woodfuel, non-timber forest products, but must embrace the overall aspects of forest management systems. This means until a forest is managed according to the principles of sustainable forest management, there could be no prospect for certification of only specific forest product from any forest. Therefore the woodfuel certification system must include all types of woodfuel production sources, including government-managed national forests, forest plantations, CF, as well as private forests and TOF.

Currently, all private forests and most TOF are in the form of small blocks of generally, naturally grown trees or isolated or scattered trees on private and institutional lands. The present land-ownership ceiling in the country is also very small and does not encourage for initiating any large-scale forestry in the private sector with commercial objective. Despite of this limitation the current woodfuel contribution of some private sources in the supply of traded woodfuels in specific areas is still significant. So far, there has been no system of record-keeping at the central level for recording total volume and value of woodfuels produced and traded in the markets at different parts of the country. But without sufficient knowledge and information about the different woodfuel production sources and their contribution in total volume and vale of traded woodfuels in the market, it would be difficult if at all possible to think of certification of sustainable woodfuel production for trade from private forests and TOF. As a matter of fact woodfuel production from these sources would be one out of many other products produced for trade and or consumption locally.

However, the direct woodfuels produced as by-products of forest harvesting, thinning or pruning from government- managed national forests and forest plantations or from FUG managed CFs seemed reasonable for consideration of initiating certification through certification of the forest management system rather than woodfuel as a product of these forests. Therefore, the principles, criteria and indicators suggested in this case study have been based on these considerations, which means certification of sustainable management of production sources or the forest, and not certification of sustainable woodfuel production only as a product.

Criteria and indicators for certification of woodfuel production systems

The philosophy of forest certification entails that products of forests traded in the markets come from sustainable managed forest fulfilling economic, ecological and social concerns. Therefore, certification has been viewed in this case study as a tool for verifying forest management that complied with a series of internationally accepted standards. In other words, the objective of forest certification would be to provide assurance to consumers that their purchases of forest products are not contributing to the destruction of natural forests either locally or globally.

A thorough review of the past forest certification in Nepal as well as the standard criteria and indicators identified and set at both international and regional level has identified six principles, 24 criteria and 84 indicators for initiating sustainable management of productive national forests under the public domain. This would include primarily the government-managed national forests and forest plantations, and the CFs. As the long-term sustainability of woodfuels supply sources for both traded and locally consumed woodfuel supply sources could not be ensured without initiation of forest certification, which means promotion of SFM, implementation of these principles, criteria and indicators would be desirable for initiating certification of the sustainable woodfuel production systems and the trade of certified woodfuels managed in the public sector in Nepal. One additional principle, four criteria and 12 indicators have been suggested for consideration exclusively for promoting the production and trade of certified charcoal.

But for the certification of woodfuels produced from private sources such as private forests and TOF, a separate monitoring mechanism which would be based on the product tracking and transformation process under the chain of custody certification method has been suggested for consideration.

Review of findings

The wood energy resources for the production of direct woodfuels in Nepal primarily included the national forests under different types of management. It included both natural growths as well as forest plantations. It was noted that direct woodfuels derived from the national forests such as government-managed forests and CF for trade, remained in the same order of magnitude as that obtained and sold from the TOF. These woodfuels were derived in the form of by-products and residues during implementation of forest management plans that prescribed matured tree felling, pruning, thinning, etc. Production of direct woodfuels under these arrangements, therefore, could not be viewed as an independent activity but part and parcel of over all forest management that allowed the harvesting of prescribed trees not only for woodfuel but also timber, NTFP and other products of importance to the society. Such plans in principle must take into consideration the social, economic and environmental perspectives at national and FMU levels and also maintain the record of product harvesting, product flow and financial transactions by developing and implementing principles, criteria and indicators for certification of SFM.

Conclusions and recommendations

This study suggests that the term "certification" could not be viewed solely as certification of the tree products such as timber, woodfuels or NTFP, but certification of overall management of the forest. And it means, until and unless forests are managed according to the principles of SFM that qualify for certification of forest management system, certification of only the products of forests such as woodfuel will not be possible.

Certification of the sustainable woodfuel production systems and the trade of certified woodfuel, primarily the direct woodfuels produced as by-products of forest harvesting, thinning or pruning, from government-managed national forests and forest plantations, as well as from FUG-managed community forests seemed possible to consider at the FMU level. But it will require a simultaneous certification of both production sources and the production process, which means the certification of forests (or wood energy resources) for initiation of sustainable management, and the certification of important forest products, including direct woodfuels for its sustainable production for trade in local markets or for export.

The standards (parameters) to be applied for certification of government-managed national forests and forest plantations and CF and for certification of specific forest products produced from these sources depend solely on the criteria and indicators (C&I) that will be developed and applied at the national and FMU levels. As achievement of SFM is a long-term commitment and takes considerable period of time, no productive function of forests can be halted indefinitely. Therefore, a rational strategy would be to identify the parameters of SFM within the country, including principles of forest management, and criteria and indicators for monitoring the move towards it. But these parameters should incorporate all common elements of C&I developed at the regional and international levels for promoting SFM globally.

Development and institutionalization of national standards of SFM is a cumbersome process, which requires the participation of important stakeholders, as well as a consensus agreement applicable for a long time. But as a stopgap measure, until a full-flagged national forest certification standard is put into implementation, development of principles, criteria and indicators for monitoring sustainable production of specific products like fuelwood and charcoal from public production sources for trade seems a reasonable approach for the short-term approach.

As no country could afford to stop its prescribed forest harvesting operations until a full fledged SFM system is in place, all routine forestry operations like thinning, pruning and logging; collection of woodfuel and non-timber forest products (NTFP) for trade, must continue side by side with institutionalization of SFM practices during management of important woodfuel resources. However, institutionalization of SFM practices in all productive national forests, forest plantations and CFs demand a long-term commitment from directly relevant stakeholders, including researchers, academicians and individuals involved in the establishment, management, flow and trade of all types of forestry goods and services.

Besides, the principles, criteria and indicators developed for the certification of government-managed national forests and forest plantations and CF and for the certification of sustainable production of direct woodfuels produced from these sources for trade, would not be applicable for the certification of direct woodfuels produced from the private forests and TOF due to already stated reasons. Similarly, the stated principles, criteria and indicators would not be suitable for the certification of sustainable production of indirect woodfuels and recovered woodfuels from all sources, and also for the certification sustainable charcoal production for promoting the trade of certified charcoal. In order to certify these woodfuels for trade, a separate "chain of custody" monitoring system has been proposed for adoption. Under this process the production and flow of these products will be tracked during transformation and transportation.

Experience from past suggested that a cheap, practical, simple and feasible means of forest certification of international standard did not exist in Nepal. This made it not only difficult but also unaffordable to implement the FSC level of standards prerequisite for all government and community managed forests without outside financial and technical assistance.

In order to institutionalize SFM in Nepal, interested stakeholders have recently formed an ad hoc national working group under the umbrella of Nepal Foresters' Association (NFA), which would coordinate the national initiatives of forest certification. The ad hoc national working group was established with representation from relevant stakeholders from GOs, NGOs and private sectors.

INTRODUCTION

Energy is essential not only for survival but also for improvement of the quality of life of the Nepalese people, through improvement in their overall economic conditions along with the economic status of the country. In this regard, the positive role of clean, affordable, indigenous and renewable sources of energy that could be produced and supplied on a sustainable basis would be significant in the development of this poor, least-developed country in South Asia. Currently, traditional biomass fuels contribute directly to the energy supply as well as in the livelihoods of great number of Nepalese people. According to CBS (2005), the total population in the country was 23.1 million in 2001, which was growing at the rate of 2.25 percent per annum. Out of the total population 19.8 million (or 85.8 percent) lived in rural areas and the remaining 3.3 million (or 14.2 percent) in urban areas. The estimated per capita GDP for the year 2004/05 was US$ 294. It is reported that between 37–42 percent of the country's population lived below the nationally defined poverty line in 1999. If the definition of "US$ a day" is applied, which is often used for the purpose of making international comparison of poverty, then it comes out to be 37%. These people have been thriving with a very low annual income of less than NRs 4 404 (equivalent to about US$ 62 per year), which is below the absolute poverty line[†], under average daily income of US$00.17 per capita. There was a wide variation in poverty incidence across various geographical regions. Poverty was much more severe in rural areas, where 8.7 million people (or 44 percent) lived below the poverty line compared to 0.76 million (23 percent) in urban areas (NPC, 2002a).

Virtually all people in rural areas relied on traditional biomass fuels, primarily fuelwood for meeting their domestic cooking and heating energy needs. Some of them were also depending on fuelwood for domestic lighting. For many of them there was no choice but to continue the use of traditional fuels for domestic energy. Similarly, the urban poor could also not afford to use the imported commercial fuels for cooking and heating and had to rely on dried biomass, primarily fuelwood, for meeting their cooking energy needs. Therefore, majority of the Nepalese people have been using and will continue to use the dried biomass fuels for energy for many years to come.

Nepal is a land locked least-developed country (LDC). It is situated between India and China in South Asia, bordering Tibet, China in the north and India in the east, south and west. The per capita energy consumption in the country according to WRI (2005) was only 14.66GJ in 2001, which was lower than the consumption of its neighbouring countries such as India 21.52GJ, Pakistan 18.46GJ and Sri Lanka 17.71GJ in that year.

The other peculiarity of the country's energy sector is a high dominance of traditional energy sources (as much as 88 percent), primarily fuelwood and other dried biomass residues such as crop and animal residues, in total primary energy consumption. The low per capita consumption of energy could be interpreted as an indicator of the present level of the national economy. Besides, political instability and insurgency had severely affected the life of the people and the economic conditions in the country for almost one decade. With recent negotiations and a peace deals between the different political parties of diverse interests, the country has now shown a sign of better days ahead. It will certainly increase the demand for energy to restart the engine of economic growth at a much faster pace than ever before.

The second section gives a general background of the energy context and the past initiatives of forest certification in Nepal, and section three provides the rationale, objectives and methodology of this study, together with the explanation of methodology design.

In the fourth section the wood energy systems have been explained, with details separated into the wood energy resource systems, the woodfuels production and supply (flow) systems and the institutions responsible for production and supply (flow) of woodfuels. Section five presents a common analysis of the woodfuels production and supply (flow) systems, including analysis of the woodfuel marketing and trade, followed by separate analysis for fuelwood production and supply (flow), and charcoal production and supply (flow).

[†] The Agriculture Development Bank of Nepal defines absolute poverty line as the per capita income of the farm family less than NRs 3,035 per year at the base year 1996-97 and the size of land ownership of less than 10 ropani (0.5 hectare).

The sixth section highlights on the issues and problems limiting woodfuel certification and in the seventh section the natural production systems suitable for forest certification have been identified. Suggested criteria and indicators for the certification of woodfuel production systems have been provided in section eight, which explains the basis for selection of principles, criteria and indicators for sustainable woodfuel production; elaborates the suggested principles, criteria and indicators for sustainable management of woodfuel resources; and describes the suggested principles, criteria and indicators. Besides, the suggested chain of custody monitoring criteria for fuelwood as well as the suggested chain of custody monitoring criteria for charcoal has been provided separately under this section.

The review of findings has been included in section nine, and the last but not the least, section 10 provides the conclusions and recommendations of this case study. The list of publications cited during preparation of this case study has been provided in references after the last section. Other information having direct bearing to this case study has been provided as appendices at the end of this report.

BACKGROUND

The energy context

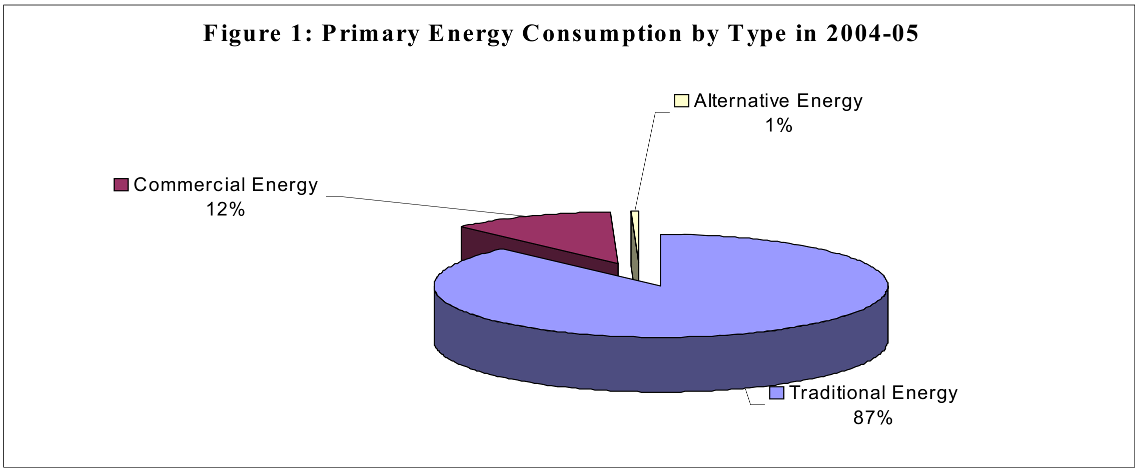
In Nepal, as in many developing countries in Asia, Africa and Latin America, traditional energy sources, primarily dried solid biomass fuels such as fuelwood, charcoal and residues of agricultural crops and animals, contributed the most in total primary energy supply. The energy statistics of the country includes three sources of energy, i.e. traditional energy (or non-commercial energy) sources in the form of solid biomass fuels, primarily fuelwood; commercial energy (or conventional energy) sources, mainly fossil fuels and electricity, including hydroelectricity; and alternative energy sources (or the new and renewable energy) such as solar thermal, solar photovoltaic-power, wind-power, micro-hydropower, including biogas (*gobar gas)* generated from cattle dung as modern bioenergy for cooking and lighting in rural areas. Their contributions in total primary energy supply in the country in fiscal year 2004-05 were approximately 88%, 12% and 0.6%, respectively. The combined share of all types of commercial energy in total primary energy supply was less than 12% (i.e. petroleum fuels 8.2% and electricity and coa1, both approximately 1.8% each), Table 1 and Figure 1.

Table 1. Primary Energy Consumption in 2004-05

Source	Amount (PJ)	Share (%)
Traditional Energy	322	87.7
Commercial Energy (Petroleum fuels 8.2%, electricity 1.8% and coal 1.8%)	43	11.8
Alternative Energy	2	0.5
Total	**368**	**100.0**

Source: Derived from MOF (2006) and verified with the data in Energy Issues in Nepal paper presented by R.P. Ghimere from WECS in RETRUD- 06, Nepal

Figure 1. Primary Energy Consumption by Type in 2004-2006



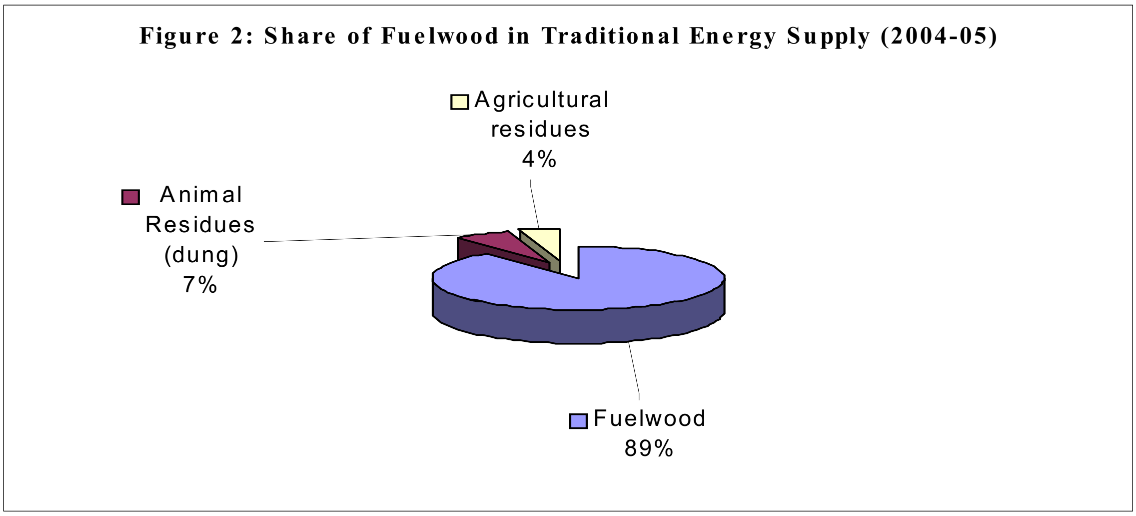
Source: Derived from MOF (2006) and verified with the data in Energy Issues in Nepal paper presented by R.P. Ghimere from WECS in RETRUD- 06, Nepal

Table 2: Traditional Energy Consumption by Type in 2004-05

Source	Amount (PJ)	Share (%)
Firewood (woody biomass)	287	89.2
Animal residues (dung)	21	6.5
Agricultural residues	14	4.3
Total	**367**	**100.0**

Source: Derived from MOF (2006) and verified with the data in Energy Issues in Nepal paper presented by R.P. Ghimere from WECS in RETRUD- 06, Nepal

Figure 2. Share of Fuelwood in Traditional Energy Supply (2004-2005)



Source: Derived from MOF (2006) and verified with the data in Energy Issues in Nepal paper presented by R.P. Ghimere from WECS in RETRUD- 06, Nepal

Within traditional energy sources, fuelwood contributed approximately 90%, followed by animal dung 6.5% and agricultural residues 4%, respectively, Table 2 and Figure2.

Until recently, biomass fuels are mostly used in traditional heat applications with primitive combustion technology, but lately animal dung is being used also for the generation of biogas (*gobargas*) to provide modern bioenergy for cooking and lighting in rural areas.

Woodfuel has been the principal energy for cooking, space heating, agro and food processing in the rural domestic sector. Besides, many traditional industries and commercial enterprises also rely heavily on traditional energy sources for process heat.

Charcoal is not at all used for cooking even in urban areas. So it has remained not so important among different types of fuels consumed in the country. Its use has so far been confined to specific end uses, such as for metal-works by black-, silver- and goldsmiths; for warmth of lactating mothers and newborn babies during the post-delivery weeks; for barbeque; and for body heating also by some urban adults during the severe cold months in winter. The commonly available energy statistics from concerned government department, however, does not include the information regarding charcoal production and consumption in the country. Furthermore, the present statistics shows a decreasing share of traditional fuels in total energy consumption, which is correct in percentage term but in absolute term its consumption too has been growing year after year. But this fact has remained unrealized by most planners. Of course, the growth in total energy consumption has predominantly been dominated by commercial sources due to various reasons. One should not ignore that a large proportion of the households in the country live in rural areas and totally rely on traditional sources for meeting their almost all domestic energy needs. Besides, many households in small towns and business centres, as well as the poor in rural areas, even today, rely on wood and agrofuels for meeting their basic energy needs, for cooking, heating, and food and agro-processing.

It is reported that the total primary energy consumed in the country was about 388 PJ (or 8.62 Mtoe) in year 2004–05. Out of which, traditional, commercial and renewable (alternative) energy sources contributed 340 PJ (or 7.56Mtoe), 45.5 (or1.01 Mtoe) and 1.8PJ (or 0.04Mtoe), respectively. Among traditional sources, fuelwood alone contributed over 78% in total primary energy consumption, followed by animal dung (6% of national share) and agricultural residue (4% of national share). All types of commercial and alternative (renewable) energy sources contributed only the remaining12 % (i.e. petroleum fuels, coal and electricity all together contributed about 11.5% and the alternative (renewable) sources contributed about 0.5%). The residential sector was the largest consumer of energy, over 90%. Of the total energy consumed in this sector about 78% was in the form of fuelwood. The industrial and commercial sectors also consumed about 0.6% and 0.5% of traditional energy, mostly fuelwood for food, mineral and agro-processing, for commercial cooking, drying, for different thermal applications, including cremation of dead bodies and for ritual fires during religious and special occasions. All other sectors of the national economy consumed only the remaining 10% of total. (Source: WECS database, May 2006).

Past initiatives of forest certification

In the recent past, two initiatives were undertaken for the certification of important forest products from community forests (CF), primarily for initiation sustainable community forest management, for promoting marketing of the forest products from CF for income generation to local people.

The first initiative was from the Private Public Alliance (PPA) program funded by USAID through Asia Network for Sustainable Agriculture and Bio-resources (ANSAB) in collaboration with the Federation of Community Forest Users Nepal (FECOFUN). The ANSAB-FECOFUN certification initiative was for promoting international trade in NTFP for generating the income opportunities to rural communities from sustainable management of CF. This exercise was one of the many activities under the integrated package of Public Private Alliance (PPA) Programme, launched in Dolkha and Bajhang districts in 2002.

The Rain Forest Alliance, a USA based non-governmental organization, assisted in the certification process to FECOFUN. So far, 21 community forest user groups, covering 14 077 hectares of community forests, have been certified under the generic standards of the FSC group certification system in the last two years. In this task, the FECOFUN served as a group manager and received a certificate of good forest stewardship from the Forest Stewardship Council (FSC). During the process many forest users group members and the staff of the Department of Forests (DoF) and non-government organizations (NGOs) serving at the local level got the opportunity of training in forest certification (Dahal, 2005).

The second initiative was by Integrated Human Ecology Project (IHEP) under the UNDP/ Small Grant Programme in 2002 (IHEP, 2004). It covered two community forest users groups (FUGs), both in Parbat district of western Nepal. The project considers the certification as a slow and gradual process that required a long-term capacity building measures at the local forest user groups' level. The aim is to attain the international certification standards only after some years of project implementation. For this, it proposes to follow a process of identification of the preliminary set of certification standards in consultation with local forest user groups, field test and improve the preliminary set of standards based on findings, again conduct a second field test and incorporate its findings for further improvement until the local standards match the international certification standards.

The immediate interest of IHEP was to improve the conditions of community forests into good forests (or *Asal Ban*), which would only be one step ahead of their present conditions and not really for promoting the export of forest products from these forests. The project gives high emphasis to the poor with incorporation of some pro-poor certification standards in community forest management. Besides, the project aims at raising the awareness about forest certification at local forest users group (FUG) level, in order to prepare FUGs to adopt and implement the FSC forest certification standards in community forests (IHEP, 2004).

FAO-RAP (2000a) reports that Nepal, as a member of International Tropical Timber Organization (ITTO), has developed specific criteria and indicators at the national level for community forestry and leasehold forestry management with the forest user groups under the guidance of Center for International Forestry Research (CIFOR). But the criteria and indicators developed under this initiative were not yet properly organized nor applied in a systematic manner. An informal communication with the person involved in drafting of the CIFOR criteria and indicators revealed that this framework comprised of six principles, 24 criteria and 83 indicators.

FAO-RAP (2000b) reports Nepal's participation in the sub-regional workshop "Development of National-Level Criteria and Indicators for the Sustainable Management of Dry Forests of Asia" in Bhopal, India, from 30 November–3 December 1999. The background paper (of Zhu, *et al.)* of that workshop presents a separate list of C&I for Sustainable Forest Management in the Region, particularly for Bhutan, China, Mongolia and Nepal, which include seven criteria and 52 indicators.

RATIONALE, OBJECTIVES AND METHODOLOGY

Rationale

In Nepal, as in many other countries in the world, the growing interest in wood (bio) energy in recent years has opened a new avenue for additional production and harvesting of wood (biomass) for bioenergy development. Side by side, this growing interest in bioenergy has raised a new concern on the presumption that increased woodfuel use to supplement imported commercial fuels may cause additional pressure on already dwindling forest resources and lead to further deforestation and ecological devastation. Therefore, it has been felt necessary to know whether the woodfuel used currently (in traditional and modern energy applications, if any) in the country comes from sustainable sources or the collection and use of woodfuels contributed to further deforestation and ecological devastation. And for this reason, a thorough understanding of the existing wood energy resource systems and the present patterns of fuelwood and charcoal supply have become crucial from the point of view of both continued use of woodfuels in traditional forms, as well as for promoting modern applications (in the form of solid, liquid and gaseous fuels or by combined heat and power generation).

In order to promote the use of wood energy in different forms in perpetuity, therefore, the first and foremost factor that needs to be assessed clearly is the sustainability of woodfuels production, which means identification of potential woodfuel supply sources, on going woodfuel production, flows and resource management systems, etc., which call for development of the national standards of sustainable woodfuels production, and ultimately the standards for all systems of biomass fuel production. In this regard, this case study has tried thoroughly to review, analyze and identify the suitable C&I of sustainable woodfuel production for trade, where sustainability implies the social, economic, ecological, cultural, institutional and legal perspectives of fuelwood and charcoal production, trade and uses in Nepal.

Objectives

The main objectives of this case study are to:

- characterize the production, commercialization and consumption of fuelwood and charcoal in Nepal,
- identify process and operation units (harvesting, preparation and production) influencing the sustainable production of woodfuel, particularly fuelwood which deserves certification and monitoring,
- identify fuelwood and charcoal flows from different supply sources: forests, planted forests, TOF, forest and industrial by-products,
- describe the specific operation units and process units involved with fuelwood and charcoal production such as: wood harvesting and preparing, wood species for charcoaling and charcoal making,

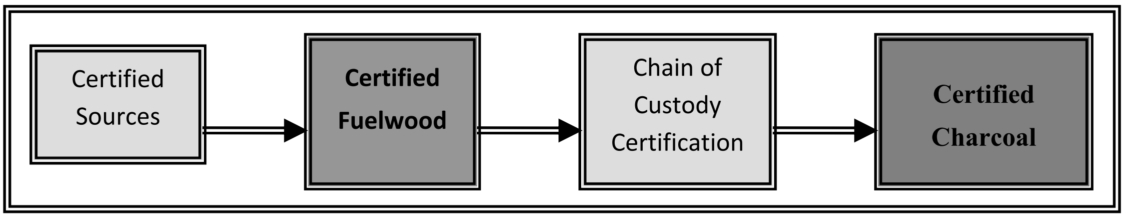
- analyze the environmental, socioeconomic[‡], cultural, institutional and legal aspects associated with production of fuelwood and charcoal derived from different supply sources (forests, planted forests, TOF, forest and industrial by-products) and using different woodfuel production techniques and,
- suggest, analyze and describe suitable criteria & indicators, which need to be monitored.

Methodology

The study has relied solely on secondary information available from different sources, i.e. published reports and documents of R&D and academic institutions, individual researchers, government forestry agencies (i.e. Department of Forests (DoF), Forest Products Development Board (FPDB), Timber Corporation of Nepal (TCN), etc. There was no collection of primary data for the purpose of this study. Relevant reports and papers by individuals, national and international organizations, including reports of relevant seminar and workshops provided additional information, together with limited interactions with directly relevant individuals. Proposing C&I for certification of fuelwood and charcoal production for trade, attention was paid to the features such as clarity, flexibility, feasibility, applicability, country's limitation, compatibility and adoptability as suggested in FAO-RAP (2000b).

Additional C&I needed for monitoring the sustainability of supply of indirect and recovered woodfuels and production and supply (flows) of charcoal were identified by adopting the *chain of custody certification* method all along, from production sites to local markets, to end users, and also during transportation and trade of fuelwood and charcoal. For the purpose of this study, the total amount of fuelwood used for charcoal making was treated as an input and the total amount of charcoal recovered under specific operation unit and process unit as an output. The suitable principle, criteria and indicators for specific operation units and production units were determined following the stages illustrated in Figure 3.

Figure 3. Stages considered for the study of sustainable charcoal production



Basis for methodology design

Taking into consideration all basic aspects highlighted above, under the six main objectives, this case study was designed for identifying the process and operation units (i.e. harvesting, preparation and production) that influence sustainable production of fuelwood, both as woodfuel or for charcoal making, which deserved certification and monitoring for trade. The design also considered the need for analyzing the environmental, socioeconomic, cultural, institutional and legal aspects

[‡] The social and economic impacts of woodfuels and woodfuel production as well as the relationship between economic activities related to woodfuel production and livelihoods

of fuelwood and charcoal production from different sources and under different production systems (techniques) in order to suggest, analyze and describe suitable C&I for ensuring sustainable production and supply of fuelwood and charcoal from existing wood energy resources. While formulating the methodology for this study, the prevailing systems of fuelwood and charcoal production and supply (flows), were familiarized by making review of the available secondary information.

THE WOOD ENERGY SYSTEMS

FAO (2004) defines the wood energy systems as:

"*All the (steps and/or) unit processes and operations involved for the production, preparation, transportation, marketing, trade and conversion of woodfuels into energy*."

In the conceptual view of wood energy systems FAO (2004) introduces three different woodfuel supply sources: a) nature - for direct woodfuels derived from forests and TOF, b) wood industries - for indirect woodfuels derived as residues and by-products and, c) society - for discarded wood recovered for woodfuels from abandoned wood products, including old furniture and demolition wood from old constructions. It also incorporates the user's side information, which is shared among the main demand sectors. Additional considerations regarding wood energy trade complete the picture. The commodities (wood energy vectors) to be considered in wood energy accounting have been divided into four types of products: fuelwood, charcoal, black liquor and others (i.e. methanol, ethanol, pyrolitic gas). The main supply sources for the different types of woodfuels (commodities) were identified as below in Table 3.

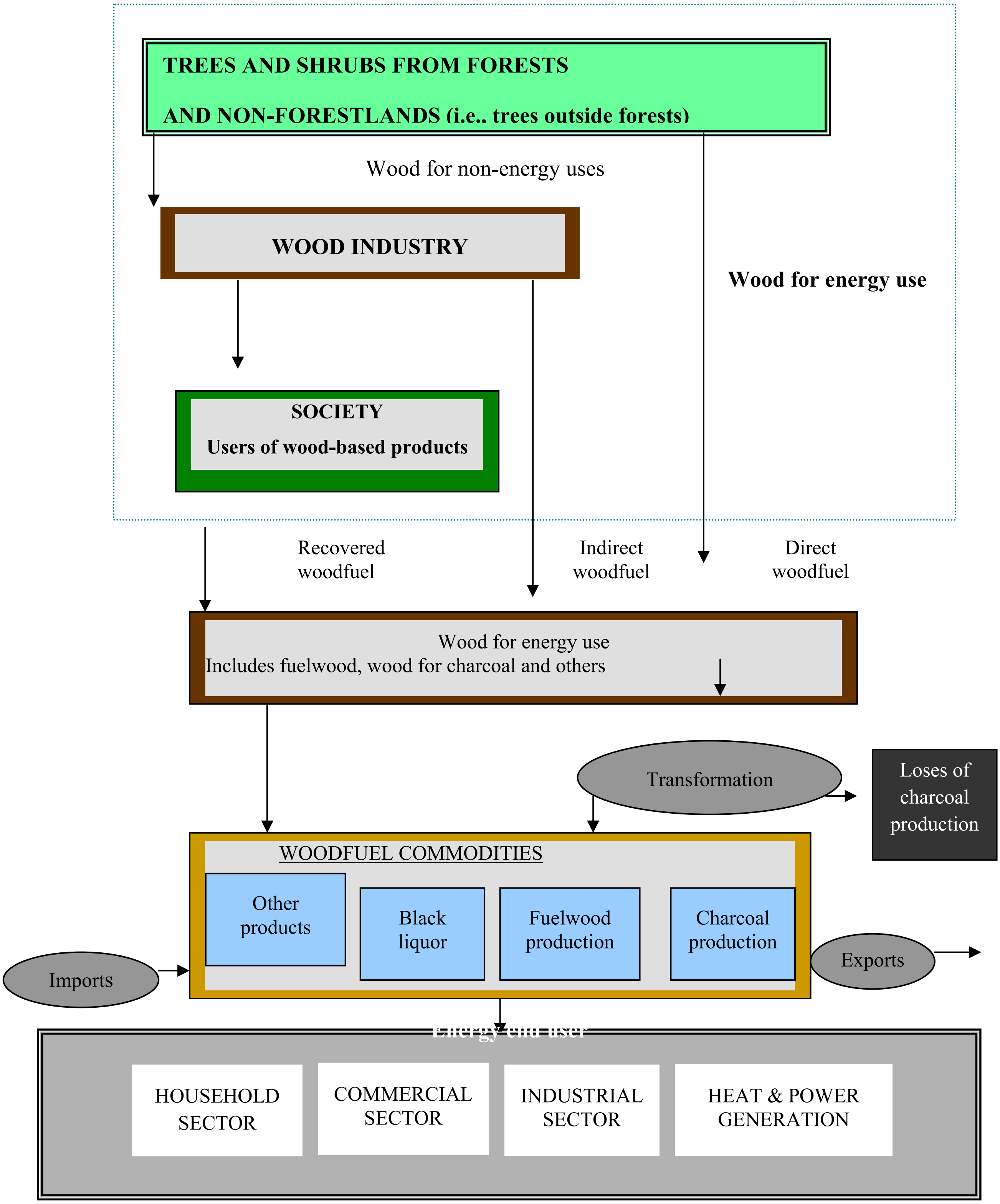
Table 3. Woodfuel types from different supply sources

Commodities (wood energy vectors)	Supply side (sources)		
	Direct Woodfuels	Indirect Woodfuels	Recovered Woodfuels
Fuelwood	x	x	x
Charcoal	x	x	x
Black liquor		x	
Other (methanol, ethanol, pyrolitic gas)	x	x	x

Source: FAO (2004)

The woodfuel balance scheme, from supply sources to end users, taken from FAO (2004) is presented below in Figure 4. The figure identifies the main supply sources (side) for different types of woodfuels (commodities), e.g. the supply sources for fuelwood and charcoal include all direct, indirect and recovered woodfuels, for black liquor only the indirect woodfuels (by-products) of wood industries, and for other types (i.e. methanol, ethanol, pyrolitic gas) all direct, indirect and recovered woodfuels.

Figure 4. Woodfuel balance scheme from supply sources to end-users



Source: FAO (2004)

Wood energy resource systems

The UBET (2004) defines woodfuels as: all types of biofuels originating directly or indirectly from woody biomass. It includes the trees and shrubs grown on forest and non-forest lands, including biomass derived from silvicultural activities (i.e. thinning, pruning) and from harvesting and logging (i.e. tops, roots, branches), as well as industrial by-products derived from primary and secondary forest industries which are used as fuel.

According to this definition, the wood energy resource system encompasses the activities related to sustainable production and management of all types of woodfuel resources, including woody biomass obtained from silvicultural activities, from harvesting and logging of trees and shrubs from forests and non-forest lands (including TOF), as well as in the form of industrial by-products and residues.

For sustainable production and supply (flow) of woodfuels, including fuelwood needed for charcoal making, scientific management of national forests and forest plantations either by government agencies or forest user groups (local communities), or by private industries and individuals, would be essential together with the management of all types of tree plantations (including non-industrial plantations and fruit orchards). Similarly, management of trees and shrubs integrated into the land and tree based production systems, including scattered trees on farms, homesteads and home gardens, farm and agro-forests, linear and blocks tree plantations and scrub lands, under public, private or community ownership would be essential to ensure a sustainable supply of woodfuels. Depending on local conditions, one or many sources could play important roles in the supply of fuelwood and charcoal for trade.

Woodfuels production and supply (flow) Systems

Fuelwood production sources

In Nepal, the most important production sources of woodfuels are the national forest under different systems of management (by government, local community, leaseholders, etc). Besides, private forests and trees on non-forest lands (TOF) also contribute to woodfuel supply in many areas. The priority of any forest owner, manager or developer would be to dispose of their forest and tree products at highest possible price in the market, whether the products are from private, community or public sources. So the Nepalese producers could not be any exception to this universal practice.

From the volume of consumption basis, fuelwood stands first amongst the different types of woodfuels. Until recently, the use of charcoal for domestic energy has also remained insignificant.

According to MFSC-DoF (1999), the legal definition of forest includes all fully or partly covered areas by trees. All forests, excluding private forests, whether marked or unmarked with forest boundary markers are treated as national forests, including waste or uncultivated lands, unregistered lands surrounded by or adjoining to forests, as well as paths, ponds, lakes, rivers or streams and riverine lands within forests.

The national forests are classified into:

- *Government Managed Forest* (a national forest managed by the government)
- *Protected Forest* (a national forest declared as a protected forest by the government, considering its special environmental, scientific or cultural significance)
- *Community Forest* (a national forest handed over to an users' group by the government for its development, conservation and utilization for collective benefit)
- *Leasehold Forest* (a national forest handed over to any registered institution under the current law, forest product-based industries or communities by the government)
- *Buffer Zone Community Forest* (a national forest around national park or wildlife reserve, which is handed over to the local buffer zone user committee for biodiversity conservation and forestry development, for fulfilling the needs of forest products of local communities)
- *Religious Forest* (a national forest handed over to any religious body, group or community by the government for its development, conservation and utilization)

The different types of national forests listed above, together with government-owned tree plantations established on national forest lands are the main supply sources of direct woodfuels. These forests are governed with specific legislative arrangements under the broad framework of Forest Act 1993 and Forest Rule 1995. These sources are important for supplying the wood, woodfuels and other forest products to local communities for self-use, as well as some for trade in commercial markets. But these resources are not distributed equitably to meet the total forest products needs of the people in every part of the country.

Depending on availability and accessibility, alternative sources such as private forests (a forest planted, nurtured or conserved in any private land owned by an individual under the current law) and scattered trees on farms, homesteads and non-forest lands (TOF) play a significant role in the supply of direct woodfuels locally. However, the crucial role of each of these sources in both locally consumed and market traded woodfuel supply remains not fully understood due to lack of information. And information is lacking not only regarding production by source, but also regarding consumption in specific end uses by type of woodfuels. This information would have been desirable for understanding the long-term sustainability of production for sustaining the traditional uses of wood energy, not to mention for assessing the potentials of modern bioenergy applications in the future.

Without reliable information about production and consumption (in both volume and value), including supply sources of direct, indirect and recovered woodfuels by types (commodities: fuelwood, charcoal, etc.) and also due to absence of any systematic mechanism for a periodic collection and updating of woodfuels related data, it was difficult to visualize clearly the specific role of each components of the wood energy systems prevailing in the country. Besides, available information shows a wide variation in the contribution of forests and non-forest lands (TOF) in total woodfuels supply, which remained site specific. Bhattarai (in WEN: Vol.15 No.1, 2000) cites earlier two sources and presents the share of forests between 73–82% and of non-forest lands 17–27% in total supply of woodfuels in Nepal.

People in different parts of Nepal adopt their site-specific woodfuel supply strategies that best suit local conditions, which depend on availability and accessibility of natural forests under the public domain. It is not true that only the remaining natural forests under the public domain are important supply sources of woodfuels to everyone living in different parts of the country. Only in areas endowed with large tracts of natural forests and/or forest plantations, owned either by the government or local communities as CF, including village and community woodlots, these public resources play a significant role in the supply of locally consumed woodfuels. But in areas with limited or non-existence of the public supply sources, trees on private, institutional and community lands play a crucial role in supplying the locally used woodfuels. Recently, community forests have started to contribute significantly to woodfuel supplies in the villages of middle hills of Nepal.

But in the *terai* plain most villagers rely more and more on private woodfuel supply sources, such as private forests and trees on non-forest lands, also known as TOF. It has been noted that the role of forest and non-forest lands change significantly from one place to another, not only between the districts but also within a district, depending upon local woodfuel demand and supply situations. It is observed that the people, rich or poor living in a close proximity to woodfuel resources rely mostly on the free, self-collected direct woodfuels from public supply sources.

Wherever these sources are in short supply, the people have been forced to switchover to other inferior biomass fuels (i.e. agricultural crop and animal residues) for energy because the remaining natural forests and shrub lands under public domain have been pushed farther away over the years due to various reasons (i.e. forest encroachment, conversion of forest for other uses, including infrastructure development, deforestation etc). On the other hand, even the poor living in urban areas have to use the purchased, indirect or recovered woodfuels for meeting its energy needs. The direct woodfuels sold in the markets are usually expensive compared with the price of indirect and recovered woodfuels, so out of reach to them.

In many rural areas, mostly in the *terai,* government or community established scattered tree plantations tend to complement the supply of direct woodfuels to local people. In other areas, the small patches of naturally grown trees on private farms bridge the domestic woodfuel supply gaps of the better-off farmers. Besides, the linear tree plantations established under different schemes, for greening, for protection of river and canal banks, as avenue trees along sides of road and railroad, contribute also to local supply of direct woodfuels to the people. In addition, the different types of trees planted under multiple objectives (e.g. for fruits, nuts, oil, spices, windbreaks, shade) on private lands, including in home gardens, homesteads, farm boundaries, or as linear tree plantations, fruit orchards, cash crops (including tea and coffee bushes, etc), contribute significantly to direct and indirect woodfuel supply.

Therefore, the wood energy resources in Nepal include all accessible natural forests, block, linear and scattered tree plantations on public, community and private lands, as well as scrubs and wastelands. And depending on local conditions, one or many sources play an important role in supplying the direct, indirect and recovered woodfuels to the people in different parts of the country. Therefore, whichever of the many woodfuel supply sources plays a crucial role in meeting the demand is very much site specific and depend on the physical, social, economic and environmental conditions of the specific area.

Balla *et al.* (in RWEDP, 1991) identifies the livestock yards as a secondary source of fuelwood for some households who own livestock. The small twigs left over after feeding fodders are used as fuelwood for household cooking on the outskirts of Pokhara town in Western Nepal. This woodfuel recovered as fuelwood from the fodder material after feeding the cattle may be placed under recovered woodfuels.

For the purpose of this case study the conceptual framework of wood energy systems of FAO (2004) has been adopted with some modifications to incorporate the different situations in Nepal. By doing so, it will try to identify and incorporate every component of the wood energy systems, including resources (i.e. forest and trees on non-forest lands), supply sources (i.e. nature, wood industries and society) and woodfuel type (or commodity like firewood, charcoal). The wood energy systems in Nepal have been shown separately by woodfuels supply sources, woodfuel types and commodities below in Figure 5(a), (b) and (c). The preferred species for fuelwood and charcoal as expressed by the producers and traders of woodfuels in Pokhara, Nepal (Bella *et al.* in RWEDP, 1991) is provided in Table 4.

All of the best species for fuelwood in the above list could be found in the natural forest of middle hills and most of it has been handed over to FUGs for management by the local community as CFs. Similarly, the best species for charcoal making could also be found in most of the CFs. Among the good species, Mango, Badahar and Jamun are found mostly on private lands raised by individuals with multiple objectives, i.e. for fruit, fodder, wood and firewood. And species is an important component of the integrated hill-farming systems in Nepal.

Fuelwood distribution

The present demand of woodfuel is primarily for traditional applications (for cooking and heating) and the types of fuels used for this purpose are mainly fuelwood and to a limited extent charcoal for specific end uses. Most of the woodfuel consumed by rural households are free-goods, which are self-produced, collected or harvested for free, sometimes by hired labour but invariably without payment of any stumpage fee or royalty. Therefore, a major share of the woodfuels consumed in the country does not pass through any formal or informal channels of commercial distribution or trade.

Fuelwood, sawdust and other woody residues produced in different shapes and sizes as by-products in wood-industries and charcoal is used for energy either by the producers or by others elsewhere. Most of these woodfuels are used in the rural domestic sector, but also many urban households and traditional industrial commercial activities rely on these fuels for energy. The practice of woodfuel distribution and use in Nepal, as in many other countries, vary according to distance from the sources of production to the consumption centres. Besides, accessibility and availability of wood fuel, socioeconomic conditions of the villagers and the amount to be transported also influence the distribution systems in specific areas.

The traditional woodfuel distribution system in rural households is simple. Often one actor does the complete task of producer (harvester/collector), transporter and consumer. The system becomes a bit complicated with rural industries and commercial activities, in which hired labours often play the role of woodfuel producers and transporters. Similar situation can be observed with the better-off households who might also employ hired labours for the collection and transportation of fuelwood for them.

But in many densely populated district centres and small towns, existing wood energy resources have become insufficient to meet the demand of energy for various end uses, including domestic cooking and heating; for traditional industries; and for food and agro-processing for commercial markets. In such areas the supply of wood fuel to end users is managed through commercial channels, as both formal and informal supplies. An overview of schematic woodfuel flow is provided in Figure 6.

Table 4. Preferred Species for Fuelwood and Charcoal

Fuelwood Species		**Charcoal Species**	
Local name	**Scientific name**	**Local name**	**Scientific name**
Best species		*Best species*	
Sal	*Shorea robusta*	Sal	*Shorea robusta*
Chilaune	*Schima wallichii*	Khair	*Acacia catechu*
Karma	*Adina cordifolia*	Kafal	*Myrica esculanta*
Tinju	*Dyospyros spp.*		
Katus	*Castanopsis inidca*		
Good species		*Good species*	
Asna	*Terminalia tomentosa*	Chilaune	*Schima wallichii*
Mango	*Mangifera indica*	Katus	*Castanopsis indica*
Jamun	*Eugenia jambolana*	Angeri	*Lyomia ovalifolia*
Khanyu	*Ficus cunia*	Khanyo	*Ficus cunia*
Badahar	*Artocarpus lakoocha*	bothdhainro	*Lagerstroemia perviflora*
Less (non) preferred species			
Utis	*Alnus nepalensis*		
Phaledo	*Erythrina stricta*		
Simal	*Bombax ceiba*		
Pipal	*Ficus religiosa*		
Khirro	*Sapium insigne*		
Pakhuri	*Ficus glaberrima*		
Bar	*Ficus bengalensis*		

Source: Bella et al. (in RWEDP, 1991)

Figure 5 (a). Wood energy systems: nature as a source of direct woodfuels in Nepal

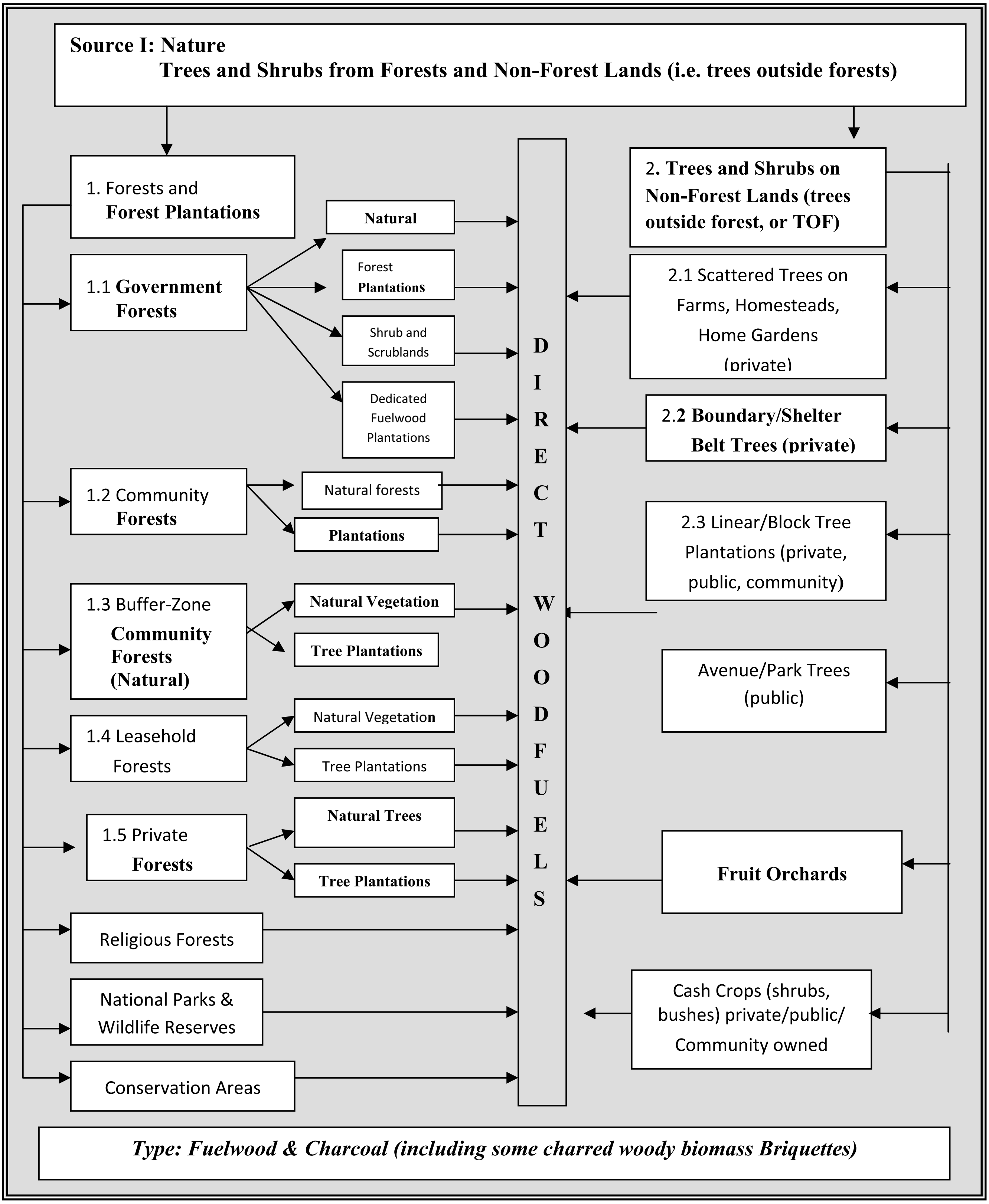


Figure 5 (b). Wood Energy Systems: Wood Industries as a Source of Indirect Woodfuels in Nepal

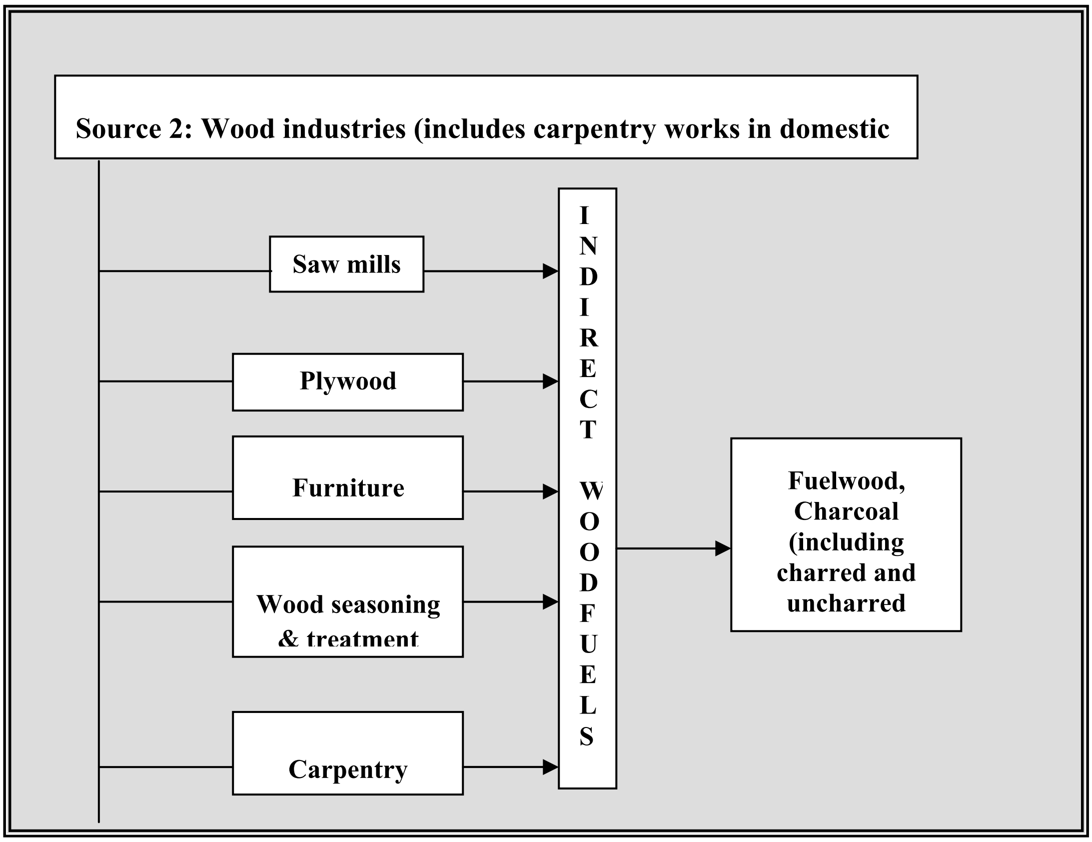


Figure 5 (c). An Overview of the Wood Energy Resources: Society as a Source of Recovered Woodfuels in Nepal

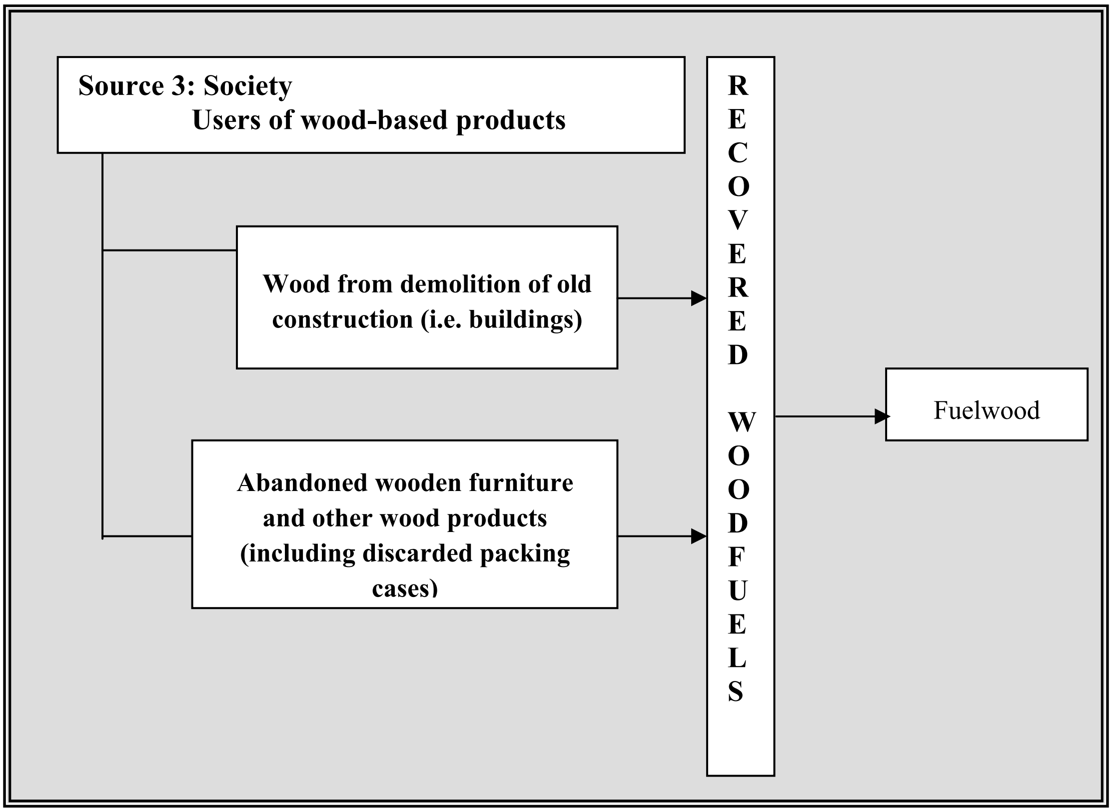
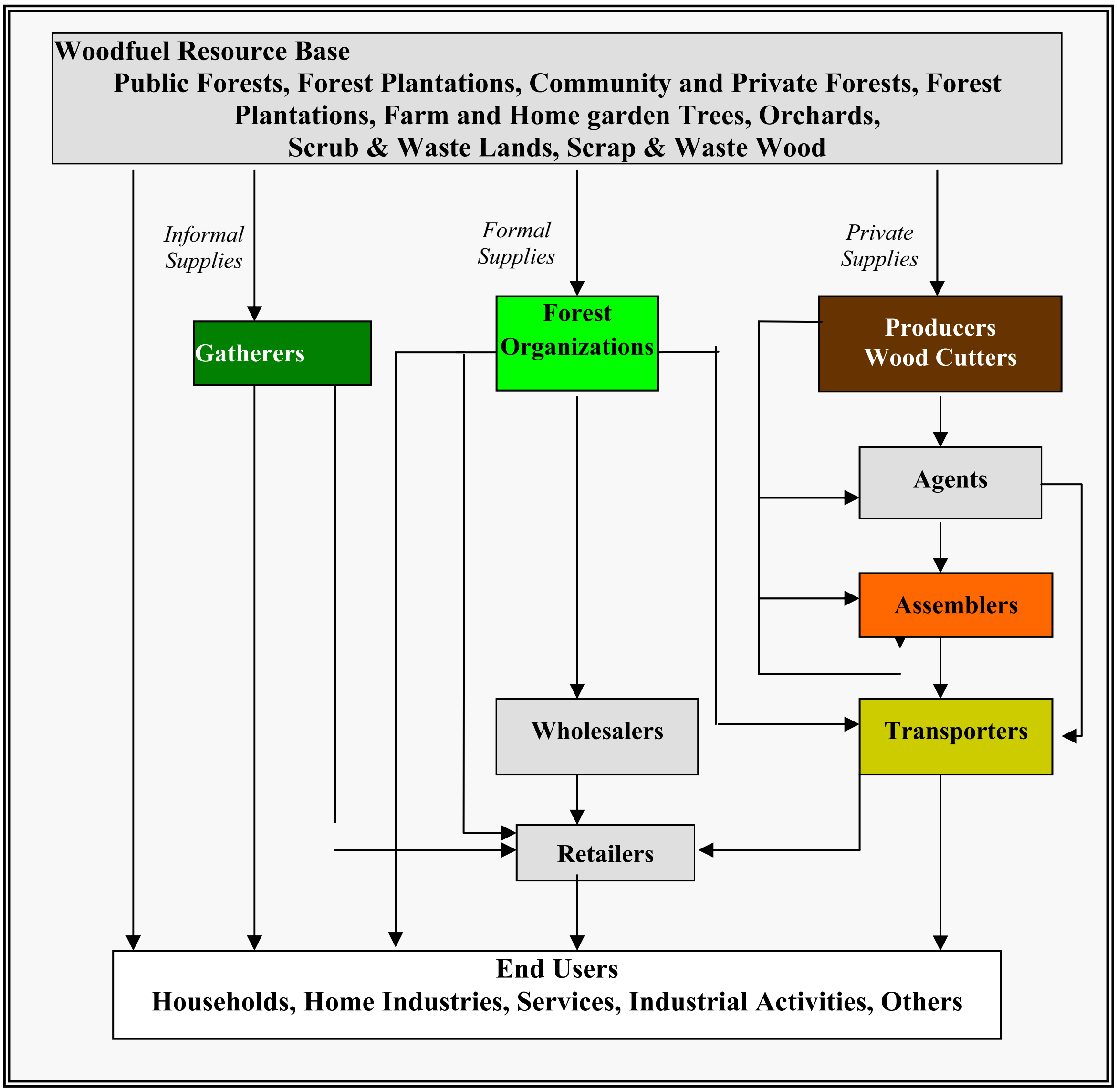


Figure 6. Overview of schematic woodfuel flow



Source: RWEDP (1996)

Kanel (1998) cites two fuelwood marketing-related studies conducted in the past. The first study (by Shaikh *et al.*) analyzed the fuelwood marketing and trade in Kathmandu valley in 1989 and other study (by Delucia and Associates) on energy pricing in 1994. The policy study analyzed also the existing situation of woodfuel in the country and the implications of current and reformed policy on the demand and supply. Kanel further states that the marketing chain of commercial woodfuel obtained through informal or illegal collection from the national forests is different. No official permit is issued to these informal/illegal collectors. Individual household members enter the national forests, harvest the fuelwood and bring it in head-load, bicycle-loads, and shoulder-loads to the nearest road side and sell either to a local trader or to an end user. Based on the proportion of fuelwood used as a commercial commodity, the estimated number of people employed in the collection and trade of fuelwood was estimated at least 100 000 in Nepal.

Another area-based study by Gautam and Pokharel (in IAAS Research Reports 1994–1995) tries to identify the existing marketing system of fuelwood in Chitwan district. The findings suggest that majority of the fuelwood collectors and sellers were either landless or marginal farmers who were mostly from the ethnic minority groups and did not have other job opportunities in the area. Most of these collectors had direct link with local hotels and restaurants to sell the fuelwood, but others had to go to the market and find the buyers.

Charcoal production and supply

Charcoal is not a common fuel used for household purposes. But it is a preferred fuel by specific occupational groups such as traditional metal workers, as it produces high temperature in a very short period of time. Charcoal has a relatively high thermal value on equal weight basis and can be transported to a longer distance at fairly low costs compared with fuelwood. Irrespective of this advantage, this fuel has not been a commonly desired energy source for domestic cooking and heating even in urban areas of Nepal.

From the point of view of fuelwood supply for charcoal making, all natural woodfuel resources including public and private forests, tree plantations and TOF, as well as any community-owned or -managed woodfuel resources are important sources. Sometimes charcoal makers might also be paying nominal prices to, or make barter arrangements with, private tree owners to procure the fuelwood needed for making charcoal. However, none of the available information suggests the use of indirect woodfuels (woody residues and by-products from wood-industries) and recovered woodfuels for charcoal making in the country.

Production of charcoal for trade is not a common activity in the country. As past efforts of charcoal production and trade with the primary objective of utilizing logging wastes in the forest after forest clearing did not succeed due to many reasons, the prevailing forestry legislation is not specific about production and movement of charcoal. Currently, there is not a single governmental organization producing or trading in charcoal. Therefore, any charcoal producer to day even if the wood used for charcoal making by them came from purchased sources such as national forests (including CF), private forests and TOF, could not legally bring the charcoal they produce for trade in commercial markets. They may however make charcoal for own use at local areas without requiring formal official approval/permit. Any private tree owner wishing to harvest the trees grown in private lands must first acquire a felling permit from the local DFO's office, which is usually a complicated process of verifying the private ownership of not only the trees but also the land on which these trees grow. Trees cut with formal approval could be converted into charcoal and used locally without any restriction, but its transportation to market for trade is not permitted under the prevailing forestry legislation.

Balla *et al.* (in RWEDP, 1991) states that participants in the charcoal production system are from low income or low caste groups. Mostly people from the blacksmith (*Kami*) and Goldsmith *(Sunar)* castes, especially landless workers and smallholders were involved in the production of charcoal around the town of Pokhara. These people produced charcoal to sell as well as for own use in their respective occupational tasks. The common charcoal making practice was based on dug-pits, but some large and regular consumers of fuelwood such as commercial establishments, distilleries, bakeries often produced some of their own charcoal as a by-product of fuelwood burning. They further state that no agency or individual in Nepal seems to be authorized to produce or distribute charcoal to consumers on a commercial basis. Their conclusion about the charcoal that was available in the Pokhara urban area then was therefore, produced and distributed on a demand basis, and illegally, mostly by rural members of the blacksmith caste who lived in the surrounding hills.

Tamrakar and Singh (in RWEDP, 2000) identify a new possibility of charcoal production from community and leasehold forests. They categorically state that the prevailing charcoal-making practices are usually illegal operations taking place largely inside the government managed/protected national forests, mostly carried out by the specific occupational groups such as blacksmiths (*kami*) and goldsmiths (*sunar*). They were of the view that the higher carbon content and per unit of weight of charcoal allow it to sell at higher price compared with fuelwood by reducing the transportation cost. They present an old estimate of charcoal consumption in the industrial sector of Nepal as 11 000 metric tons, based on study report of the Industrial Services Center conducted during 1985–86.

Nienhuys (2003) in his report prepared for the Namche Bazaar Conference of May 2003, in conjunction with the celebration of the 50th anniversary of the first ascent of Mount Everest by Sir Edmund Hillary and Tenzing Norgay Sherpa on 29 May 1953, talks about the potential use of biomass charcoal briquettes and improved briquette stoves at high altitudes in Nepal. The report categorically states that with proper application of the available technology, biomass briquettes can be a means of providing a convenient source of energy for cooking and space heating. It could even substitute the use of imported kerosene, which is expensive, non-renewable and subsidized by the government to reduce the cost to consumers. Further, the need to improve the locally manufactured biomass charcoal briquettes has been also identified by various national and international agencies working for the development of mountain region in Nepal.

Institutions responsible for production and supply (flow) of woodfuels

In the public sector, three institutions: the District Forest Products Supply Committees (DFPSC) under Department of Forests (DoF), the Forest Products Development Board (FPDB) and the Timber Corporation of Nepal (TCN), both under Ministry of Forests and Soil Conservation (MFSC), are the key players in the production and supply of woodfuels in the markets. Currently, none of these institutions produce or trade charcoal in the country.

Department of Forests (DoF)

The main institution responsible for managing all affairs of forestry, including management of wood energy resources, is DoF. It was established in 1951 (2008 BS). The institutional reform in 1993, for decentralization of the activities of DoF, has established 74 district forestry offices (one short from the total 75 administrative districts in the country), 92 *Ilaka* (Sub-district) offices and 698 Range posts. The district of Mustang does not have a district forest office, where the District Soil Conservation Office has been assigned this role by MFSC (DoF, 2003).

For the distribution of wood and fuelwood to the local people at concession rates, 33 District Forest Products Supply Committees (DFPSCs) have been set up in the country under the Forest Rule 1995 (2051 BS). Currently, the local District Forest officer (DFO) serves as chairperson and the Attached Officer of concerned district forest office as member secretary in the DFPSC. The other members in the committee include the District Account Comptroller and the local level nominees of MFSC. DFOs are the main actors in the disposal of forest products from the government-managed national forests, either through the DFPSCs or TCN or FPDB in these districts.

In districts where part(s) of existing national forests/forest plantations have been handed over as CF to local FUGs, their respective Forest Users Committee (FUC) distributes the needed forest products to eligible FUG members. The FUCs are registered legal entities and they have to follow the prescriptions of approved working plans while harvesting of forest products from their respective CFs. Actually, the role of FUCs in distribution of forest products, particularly in hill districts have increasingly come into limelight, as suppliers of forest products at concession rates to local communities, as well as for supplying the market with surplus forest products for trade. The FUCs are responsible for development and conservation of handed over national forests together with utilization of the benefits of CFs at equitable basis. Kanel (2004) reports that more than 14 300 FUGs were managing over one million hectares (or 25 percent of the country's forests) in which about 1.5 million households (or 35 percent of the population) were involved, and generated about NRs 913 million from the sale of forest products, including saw logs, fuelwood, grasses and other products.

The other important actors in woodfuel production and trade include the private forest and tree owners and forest entrepreneurs. They are involved in the production (including TOF) and trade of forest products as informal undertakings. But all the producers and suppliers of market traded wood and woodfuels have to follow the complex and cumbersome institutional hurdles, not necessarily legal, for completing the formalities needed to bring their products to markets. Although exact information about the extent of private forests and number of trees on private lands could not be estimated, the record of DoF suggests that about 13 471m^3 (or 475 511cft) of saw logs were produced for trade from the private forests, including TOF (DoF, 2006).

Five Regional Forest Directors under the MFSC are responsible for monitoring of the forest working/operational plan implementation in national forests, including forest plantations (i.e. government-managed forests, community forests and leasehold forests), by the concerned DFO under their respective regions. In the case of protected areas, the concerned warden is responsible for assisting FUGs in buffer zone community forests.

Forest Products Development Board

The Forest Products Development Board (FPDB) was established in 1976 under DoF. Now it is placed directly under MFSC. The main reason behind setting up FPDB was to support the forest industries by providing raw materials on a regular basis, as well as for conducting research on forest utilization.

Currently, it has three operational forestry development projects: the Sagarnath Forestry Development Project in central plain, the Nepalganj Forestry Project in mid-western plain, and the Ratuwa-Mai Plantation Project in eastern plain. It has an executive committee comprising of three members. Currently, the Secretary of MFSC chairs it and other two members include the representative of Ministry of Finance (MoF) and the representative of DoF.

The Timber Corporation of Nepal

The Timber Corporation of Nepal (TCN) was established under the Company Act in 1960. Initially it comprised of a large sawmill located at Hetauda, Makawanpur district in central Nepal. The primary reason for setting up this sawmill was for a speedy clearing of the delineated forests for human settlement and for processing of the saw logs recovered from forest clearing into commercial timber, both for local sale and export. But its current activities are confined only to collection and conversion of dead, dried and fallen trees in forests with approval from the DFOs into saw logs and fuelwood. Its activities are mostly confined in the *Terai* forests. It sells the forest products harvested at auction after fixing a minimum floor price, which includes government royalty rate, plus harvesting, yarding, transportation and other associated costs, including a fixed share of mark-up as profit. The concerned DFOs assign the tasks to monitor the activities of TCN on behalf of DoF.

ANALYSIS OF WOODFUELS PRODUCTION AND SUPPLY (FLOW) SYSTEMS

Currently, most of the fuelwood consumed in the country is by rural households and traditional industries. It is totally a new scenario compared with the situation about two decades ago. Then, even the urban households depended on fuelwood for domestic cooking. In recent years, people in urban areas have rapidly switched over to commercial energy sources, primarily LPG and kerosene for cooking and heating and electricity for specific end uses. The cost of indigenously produced hydroelectricity is more expensive than the imported fossil fuels, the cost of which is supposed to be subsidized from the public sources, but at the same time there is also direct and indirect taxes on it at the time of import. And year after year, more and more people are switching over to imported commercial fuels for domestic energy, even in small towns and district centres having road access for transportation of these fuels. On the other hand, most rural households usually gather the fuelwood they need for domestic energy free of cost at the source by themselves because of their low economic conditions.

The people who live in emerging market places along sides of newly built roads, in small towns and district headquarters not yet connected with roads, depend on fuelwood or other biomass for energy, for cooking of food and cattle feed, for space and water heating, and for agro and food processing for self-consumption as well as for the market. Some use these fuels also for sustaining their traditional occupations. Most of them rely on traded fuelwood supplied through formal or informal channels of marketing.

However, the poor, as they could not pay for the fuelwood sold in the market, are forced to look for nearby free collection sources for meeting their cooking energy needs and some also for generating cash income for sustaining their livelihoods. The exact volume and value of the fuelwood traded in the country is not known, neither is the amount consumed as self-collected or free-supplied fuelwood. Generally the poor, both in urban and rural areas, have a tendency to search for free supply sources or depend on nearby natural forests, public lands etc. for free collection of fuelwood. In contrast to the users in large urban areas who purchased fuelwood for specific end uses, the poor in these areas, as far as possible searched for free or cheap fuelwood supply sources. Some of them used the waste or recovered wood available locally in different forms, if the free supply sources do not exist in the area, according to Bhattarai (2000).

Woodfuel marketing and trade

Supply of woodfuels to markets, in large urban centres, emerging market places along newly constructed roadsides and in small towns and district headquarters not yet connected with road, has evolved into a fuelwood business, mostly run in the informal sector. It has developed its own network between the tree growers and woodfuel producers, transporters and traders and consumers or end users. The non-traded wood fuel flow is a simple distribution system. There may be only one actor performing the task of fuelwood production and transportation up to the household where it will be consumed. The consumer may serve as the producer/gatherer, converter and transporter and no other actor may be involved in between.

The traded or commercial fuelwood flow systems may vary from place to place depending upon local conditions, not only between districts and towns but also between places within one district or a town. Many factors play a role in the design of a flow system in a particular area. The system may be a simple one, linking the producers with traders and consumers, or it may be a very complex one having many actors in between the producers and the consumers of fuelwood, i.e., contractors, labourers, transporters, middlepersons, wholesalers and retailers.

The price of informal sector supplied fuelwood is fixed by the market itself, which could fluctuate according to the supply-demand position at any specific time. In the case of formal sector supplied fuelwood, the DoF charges the fixed royalty rate of the government, which is based on per stack volume of specified size. The government could change the royalty rate of woodfuels from time to time taking into consideration the going market rates.

The DFPSCs supply saw logs and fuelwood for own use to the local people at fixed royalty rate of the government in specified districts. Any forest products procured under this system will not be allowed to sell. The TCN and FPDB sell saw logs and fuelwood by auction on or above the prefixed minimum floor prices which include the royalty rate plus the costs of harvesting, transportation, overhead, including predetermined percentage mark-up as profit. The total volume and value of saw logs and fuelwood trade through these official channels of the government, for past five years is provided in **Table 5.**

Table 5: Total volume and value of traded fuelwood and saw log

Financial Year	Fuelwood Stack volume (ft^3)*	Saw log (ft^3)	Amount (NRs) **
2005-06	1,970,500	1,405,858	416,586,107
2004-05	11,068,000	1,443,933	427,212,133
2003-04	3,378,000	2,191,964	545,549,749
2002-03	3,905,000	3,359,625	520,406,553
2001-02	3,479,000	2,326,669	406,863,552

Source: Kalpa Briksha, Quarterly News letter of DoF, January 2007 for the latest data 2005-06; Hamro Ban, Progress Report of DoF for data from financial year 2001-02 to 2005-06.
**1m^{3} = 35.31ft^{3}; **1US$ = 71.00 NRs (February 2007)*

Fuelwood production and supply (flow)

Woodfuel production and supply (flow) systems include the series of activities related to procurement, harvesting/collection, conversion/preparation, bundling, to transportation-transformation of woodfuels to consumption points. Therefore, in commercial flows, there will often be a large number of actors involved in the process as collectors, gatherers or hired labours, as harvesters, converters, charcoal makers, bundlers, loaders, transporters, traders (i.e. middle-persons, wholesalers, retailers) etc. The flow system may vary significantly from one place to another depending on local conditions. If the long-term objective is to promote sustainable wood energy utilization then the study of woodfuel production and supply (flows) systems must include both commercial and non-commercial woodfuel distribution systems.

A thorough understanding of the resources systems, which may include the public, community or privately owned/managed tree production systems of different kinds that may be based on forest or non-forest lands, will be essential to assess the woodfuel production potential, including the amount available for sustainable utilization. This information will also help to identify the different linkages that may prevail between the producers and consumers in the flow process, depending upon the type of the supply sources and the characteristics of the end users. The prevailing woodfuel flow system in a given area may have both vertical and horizontal linkages of variable nature, to link the different production systems with the diverse end users. A free or self-collected supply for own use may exhibit the closest link between the resources and the consumer of woodfuel. A self-collected supply partly for own use and partly for market trade may still have a shorter route, whereas a purchased supply for market trade could involve a much more complex chain of actors in the flow process.

In Figure 6 above, line one and two from the left show the directions of flows from wood energy resource base to end users, which represent the typical cases of non-commercial flow of both fuelwood and charcoal in rural Nepal whereas the next two lines on the right represent the commercial flows, including formal supplies through government organizations and private supplies through number of actors in the flow chain making the process more complex. Both of these flow models prevail in large towns and in industrial commercial centres where fuelwood and charcoal are sold as traded commodities in commercial markets.

Kanel (in RWEDP, 2000) states that the amount of fuelwood derived from private forests and trees is about the same in order of magnitude and as that obtained from the national forests. But the amount of fuelwood derived from community forests for trade was reported negligible. Only 4.7 to 7.4 percent of the total commercial fuelwood marketed in the country is legally harvested either from national or private forests. The marketing chain of commercial fuelwood obtained through informal or illegal collections from national forests is different. No official permits are issued to these collectors, as individuals and household members enter the national forests, harvest the fuelwood and bring it in head-loads, bicycle-loads and shoulder-loads to the nearest road side for sale to the local traders or to end users. Some of the bus or truck drivers are the major carriers of this fuelwood to the urban centres. They purchased the fuelwood stacked on the road, and eventually sell it to wholesale or retail merchants of the town. The proportion of commercial fuelwood supplied by these “silent travellers” is significant. It is reported that between 3–6% of the woodfuel supplied in Kathmandu valley was in the form of head- and back-loads; another considerable amount by occasional and non-professional traders as piggyback loads. Some of these carriers may also be receiving extra cash income from the woodfuel trade.

The prevailing formal traded fuelwood flow systems from government-managed (owned) forests, taken form RWEDP (2000), is provided below in Figure 7.

Figure 7. Formal fuelwood supply (flow) in Nepal

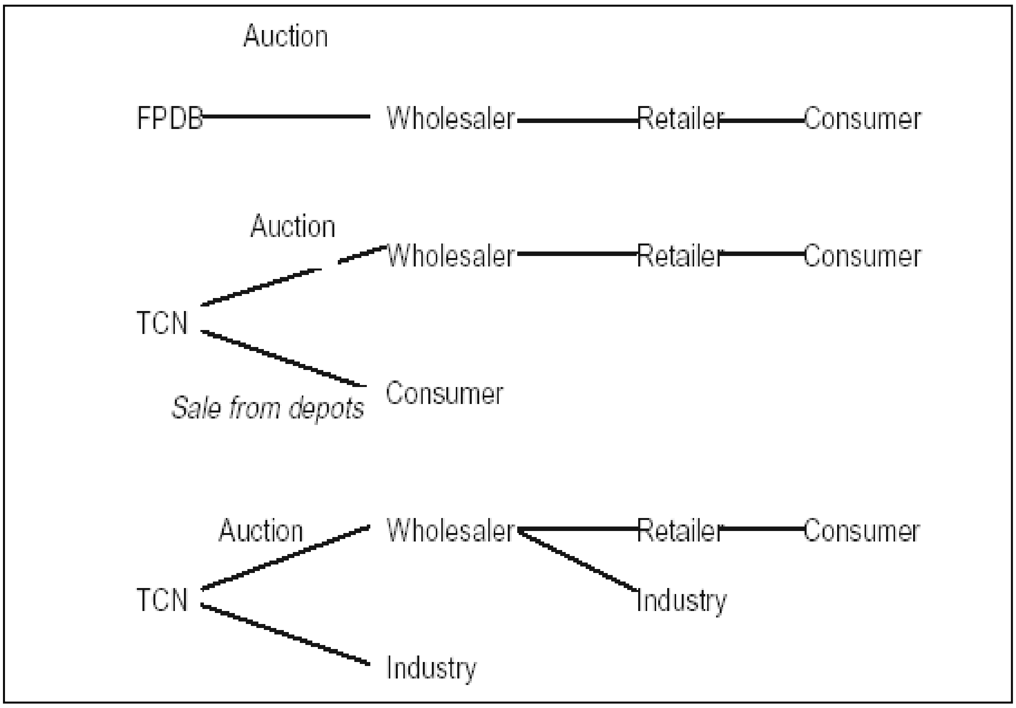
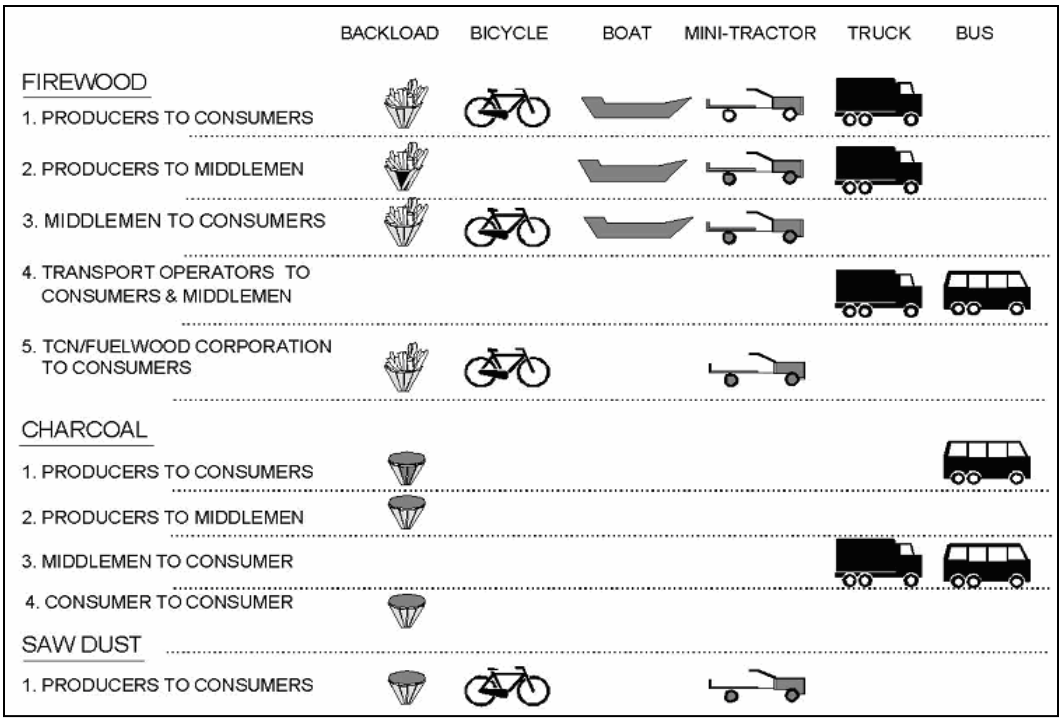


Figure 8. Distribution and transportation of wood energy in Pokhara, Nepal



Balla, *et. al.* (in RWEDP, 1991) present a more complicated wood energy distribution and transportation system that was exposed from their study in Pokhara as shown in **Figure 8**. RWEDP (2000), the recommendation of one of the groups in the National Workshop on Woodfuel Trade in Nepal, categorically states that due to the lack of management and fixed harvesting plans as well as the inaccessibility of hill forests, fuelwood production from government-managed forests is irregular and insufficient to meet the growing demand in other places. Community forests are managed mainly for protection purposes and due to non-existence of road access whatever surplus wood and fuelwood that could be available from community forests could not be brought to the commercial centres.

Private forests produce substantial amount of fuelwood for local markets but the amount produced and sold in the markets remains unrecorded. Fuelwood is considered a by-product of timber production in both public and private forests. People with small land holdings may have only a few scattered trees on their lands so the sustainability of such production systems could not be guaranteed.

The volume of traded fuelwood supplied through formal channels of the government is small compared with the volume consumed in the commercial markets. So, the amount and source of supply for the difference is generally unknown. Similarly, even if most of the fuelwood traded in the markets came currently through the informal sources, no data exist to explain the supply sources and production methods.

Charcoal production and supply (flow)

In most cases the charcoal making technologies in use are primitive. It is often a dug-pit that is very wasteful in terms of charcoal recovery. It was found that some forestry-related agencies had tried to produce charcoal in the past for promoting its commercial use, but these did not continue beyond their experimental phases due to various reasons. Some projects had even tried to produce charcoal for commercial trade on experimental basis using efficient imported charcoal kilns of portable nature, e.g. improved metallic Mark V Kiln, locally built brick and cement kilns, beehive kilns, etc. However, those efforts could not be sustained due primarily to economic and social reasons. Most of the charcoal produced under these projects could not be sold neither in the country, nor exported outside. Therefore, until recently there is not a single recognized (legally authorized) agency in the country that could produce charcoal for trade. So, whatever charcoal is being currently produced for trade must be supplied through the informal sector as an illegal venture. It has been noted that most of the fuelwood used for charcoal making at present is collected or harvested from nearby public forests without proper permits. Besides, making of charcoal inside the forest is also not allowed under the prevailing forestry legislation, even if the fuelwood used for charcoal making was from legally procured source, from government forestry agencies.

ISSUES AND PROBLEMS LIMITING WOODFUEL CERTIFICATION

Currently, only a limited amount of woodfuel is traded in the market for use by some urban households and in specific industrial and commercial activities. The prevailing market price of woodfuel is not fixed according to its cost of production and in most cases the market price is reported to be on the higher side. It may be because of the irregularity of production in the formal sector and a high dependency of the market on the informal supplies, including illegally collected/supplied stocks from the national forests as well as the private sources.

The misconception about fuelwood use and deforestation, which was perceived during the mid 1970s, has discouraged sustainable development and use of renewable woodfuel resources in virtually all developing countries in Asia including Nepal. The Forestry Sector Master Plan of 1988 proposes a three-prong strategy for managing the fuelwood supply-demand imbalance: by enhancing the fuelwood supply through better management of existing forests and establishment of fast growing fuelwood plantations, by reducing the fuelwood demand through improvement of combustion efficiency of burning devices and by promoting the use of commercial energy substitutes to overcome the fuelwood supply shortages. But the FSMP fails to acknowledge the renewable potential of wood energy resources for sustainable utilization in both traditional and modern bioenergy applications. Instead, the government has introduced a subsidy policy to encourage the use of imported fossil fuels like kerosene and LPG for substituting the energy need of the domestic sector for cooking and heating.

Until recently, not all national forests have been put under scientific management either under any forest working plans or under any operational plans. In the absence of such plans, it would not be possible to institutionalize any system of forest certification. Besides, the present forestry organization was set up in a traditional way. Many practicing foresters even today behave as controllers rather than managers/technical back-stoppers in matters related to national forest management for initiating SFM. Except for some limited initiatives of C&I development in the past, exclusively for the certification of sustainable CF management and the certification of sustainably produced NTFP for trade, a comprehensive national standards have not been developed as yet. Without which, the needed for certification of any forest product including woodfuels produced from any type of forests, whether government managed, CF, private or TOF, could not be considered for institutionalization.

Some discrepancies were observed between the provisions of the Forest Act 1993 and the Forest Rule 1995 from the point of view of assessing their compliance with the regional initiatives of C&I development under the aegis of FAO-APFC. The discrepancy was specifically on the issues related to biodiversity conservation in national forests: people's participation in national forest management; conversion ratio between standing volume, saw log and fuelwood volume (by species and tree size); sustainable level of forest products harvest; conditions for imposing ban on forest harvesting or harvesting of specific tree species (even that grown in private lands); monitoring of forest protection and management; transparency of forestry operations and records; compliance with the provisions of international conventions and protocols, etc.

The Buffer Zone Management Rule 1996, promulgated under the provision of National Park and Wild Life Conservation Act 1973, allows setting aside and handing over specified parts of a buffer zone to interested Buffer Zone User Committee (BZUC), for protection and management of these areas as Buffer Zone Community Forests (BZCFs). Before handing over of a BZCF to an interested BZUC, a tri-partite agreement must be signed between the concerned national park/wildlife reserve, the BZUC and the applying BZCF users committee. The concerned warden must assist the BZCF during preparation of an operation plan, if requested. Although the BZUCs are allowed to harvest and use the forest products within the boundary of the BZ, the surplus forest products are not allowed to be transported outside for trade. This condition could act as a disincentive for sustainable management of BZCF.

Similarly, this rule allows also to set-up a religious forest or private forest in the specified parts of a buffer zone and hands over to these areas to interested religious institution or private individual or to a business company (MFSC, 1996). But the conditions laid down under this rule seem biased towards wildlife conservation than overall biodiversity conservation.

However, representation of the minorities and ethnic groups has been reported minimum in both FUG and FUC that have been setup for managing and sharing of the benefits of CF and BZCFs. Besides, many stakeholders often questioned the long-term sustainability of these registered non-governmental organizations.

Similarly, there is ambiguity between the Forest Act 1993 (and Forest Rule 1995) and the Local Self-Governance Act (LSGA) 1998 regarding the definition of forest. According to the former, forest includes all fully or partly covered areas by trees that are not registered as private lands. Its protection and management, including harvesting and trade, therefore, lies under the jurisdiction of MFSC. But at the same time, the latter act allows the concerned Village Development Committee (VDC) to raise income from the sale of wood and fuelwood produced from the dead and dying trees, lops and tops and stumps, including the sale of thatch grass from sources within the VDC boundaries. VDCs are also allowed to raise taxes for the occupational use of natural resources that lie within their territories, including occupations based on the use of local forest products. Similarly, the District Development Committee (DDC) is allowed to impose taxes on the use of local products and services, including sale of fuelwood recovered from floating wood during rainy season and share of the income with concerned VDC and municipality (MLJ, 1999).

A coordinated woodfuel promotion programme is still lacking which would have been useful for linking and promoting the efforts of different development partners towards sustainable woodfuel utilization in the country. The prevailing legal procedures for collection/harvesting and transportation of forest products including woodfuels are complex and have been recommended by various studies for simplification in order to promote their trade.

RWEDP (2000) reports that due to small size of land holdings, there are few fuelwood trees on private land. Private forestry is further discouraged by the cumbersome bureaucratic procedure to obtain a permit to harvest and transport forest products.

The present system of fuelwood procurement for charcoal making, including its local use or trade has been commonly viewed as illegal in the absence of a clear cut rule governing its production and trade. In the recent past, there has been no activity related to sustainable woodfuel production for charcoal making, either for own use by occupational groups or for trade except the limited efforts of densification of loose biomass (woody or non-woody), either charred or un-charred, into biomass briquettes for supplementing the domestic energy supply mostly in rural areas and small towns. Besides, there does not exist any training manual or training programme for disseminating information related to efficient charcoal making techniques suitable to local charcoal dependant occupational groups.

NATURAL PRODUCTION SYSTEMS SUITABLE FOR FOREST CERTIFICATION

While preparing this case study, the term “forest certification” was viewed not solely in terms of the certification of specific forest products such as timber, woodfuels or NTFP, but for overall forest management systems. Which means, until and unless a forest is managed according to the principles of SFM and qualify for certification of sustainable management system, there could be no prospect for only certification of specific products from any forest.

Within these premises, the natural production sources of direct woodfuels (or the wood energy resources) could also not be considered only for the certification of woodfuels with the interest of promoting the trade of certified woodfuels. The natural sources of direct woodfuels production, which include government-managed national forests, forest plantations and CF, as well as private forests and TOF, therefore, all call for certification if the objective was to promote the trade of certified woodfuels in the country which would require a simultaneous move for the certification of both, production sources (i.e. forests or wood energy resources) as well as specific forest products (i.e. saw log, woodfuel, NTFP). This means that initiation of a duel certification process for both forests (which is the supply source) and important forest products like direct woodfuels, for promoting its trade in local and export markets, on the basis that these have been produced from sustainably managed sources and certified for trade.

Although private forests and TOF produce a substantial amount of direct woodfuels for trade, these forests and trees are not planted under any mandatory legislation or under a scientific land-use plan, i.e. land-use system based on land-zoning, topography, carrying capacity or under voluntary adoption of recommended technical land management prescriptions. Therefore, the private forests and TOF could not be included for the certification of specific products such as woodfuels. Besides, the long-term sustainability of these production systems also currently remains under question.

Further, whatever private forests exist today are basically in the form of scattered or limited number of naturally grown trees or small block plantations (in patches) on private lands. The total number of trees in any of these production systems would mostly be in hundreds and rarely in thousands which makes it impossible to think about introducing a system of forest certification for these resources. In addition, the present land-ownership ceiling in the country does not encourage any large-scale private forestry for commercial production. These production systems would, therefore, not be possible to cover through a standard set of principles, criteria and indicators as suggested for the certification of forests under government or community management, even if these sources contribute significantly to the traded direct woodfuels supply.

Similarly, certification of indirect woodfuels and recovered woodfuels that are produced in different shapes and sizes outside of forest areas, mostly in wood-industries and non-forest lands could not be considered suitable for certification by using the general principles, criteria and indicators of forest certification as suggested above. However, these products would require a monitoring system that could be based on the principle of product tracking and transformation under the chain of custody certification system.

Similarly, the certification of sustainable charcoal production for promoting the trade of certified charcoal could also be not considered with the generic set of principles, criteria and indicators and has been suggested for monitoring its production and trade by adopting the chain of custody monitoring system. The primary objective of the chain of custody monitoring system would be to prevent/avoid illegal harvesting and conversion of trees into charcoal from any potential direct woodfuels production sources with a legal document or a permit from the concerned authority managing the national forest including CF.

CRITERIA AND INDICATORS FOR CERTIFICATION OF WOODFUEL PRODUCTION SYSTEMS

The philosophy behind forest certification is that product is produced from sustainable forest management fulfilling economic, ecological and social concerns. So, it is a tool for verifying that forest management complies with a series of internationally accepted standards. The objective of forest certification is therefore to provide assurance to consumers that their purchases of forest products are not contributing to the destruction of the natural resources locally and the world's forest globally. And it is ensured by keeping a label in the product by which consumer identifies it as produced from sustainably managed forests (IHEP, 2004). Before deciding what parameters to consider for the certification of sustainable production of direct woodfuels from natural sources, from national forests of different kinds (including government-managed forests, community forests, leasehold forests and buffer zone community forests) and forest plantations, a thorough review was made of the past initiatives of forest certification.

Selection of principles, criteria and indicators for sustainable woodfuel production

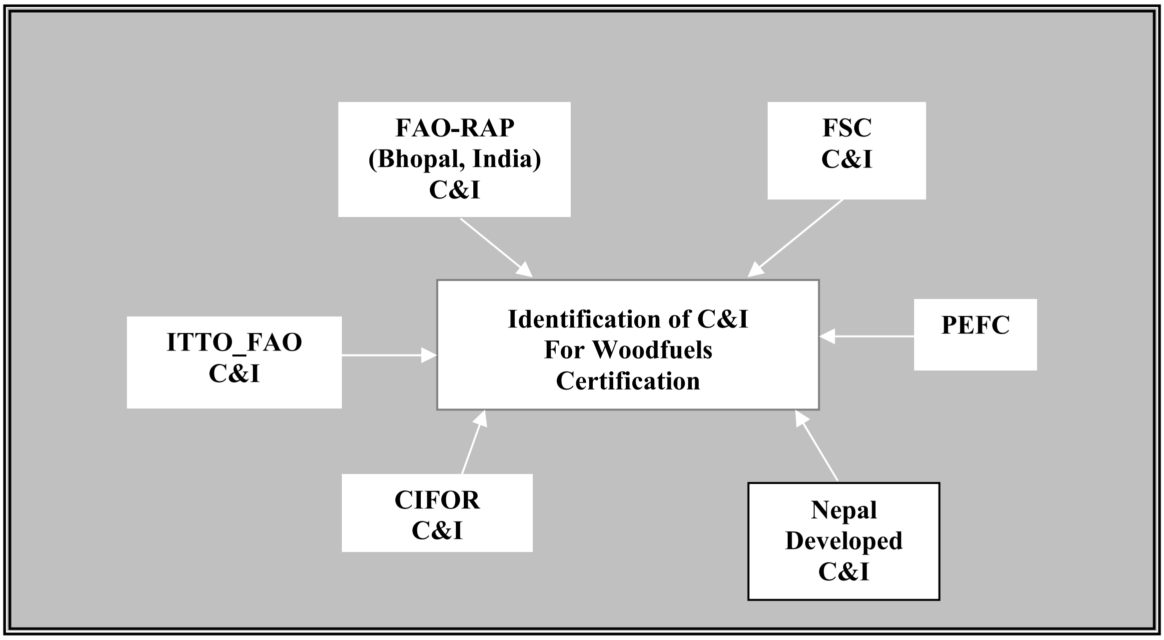
At first, information about past forest certification initiatives under the aegis of different forestry development agencies, including bilateral and international forestry development partners, is collected and analyzed in order to form a broad idea about the current status of principles, criteria and indicators development at national, regional and international levels. After a thorough review of the collected information, an idea about the starting point of this case study was formed which is therefore limited to available secondary information to-date.

As a starting point, the ITTO-FAO (APFC) standard C&I set was reviewed, followed with the proposed C&I set at the regional workshop on "Development of National-Level Criteria and Indicators for the Sustainable Management of Dry Forests of Asia", in Bhopal, India in 1999, more specifically the proposal by Zhu, *et al.* in the background paper (FAO-RAP, 2000b). This proposal remained within the framework of ITTO-FAO (APFC) and proposed seven criteria and 52 indicators for promoting SFM in the dry forests in Bhutan, China, Mongolia and Nepal, Appendix 1. This set of C&I was later reformulated by the participants from Bangladesh, Bhutan, China, India, Mongolia, Myanmar, Thailand and Sri Lanka which now comprises of eight criteria and 48 indicators, Appendix 2. It was found that there was no major difference in the content of these two sets of criteria with that of ITTO-FAO (APFC) set, except the fact that the latter set of criteria tried to make it more specific to the dry forests of Asia by slightly amending the proposed set by Zhu, *et al.* at the Bhopal workshop. And the latter set of reformulated indicators has reduced the number of indicators from the point of view of making it specific to the issues of dry forests to be addressed. The above sets of C&I provided invaluable clue for the formulation of principles, criteria and indicators for the certification of sustainable woodfuel production system for this study.

In the next step, important known principles, criteria and indicators of SFM developed and adopted at local level under different donor assisted projects, including ANSAB-FECOFUN; UNDP-IHEP; and CIFOR in Nepal, were reviewed. These initiatives, during their formulation stage, seem to have taken into consideration the long-term social, economic and ecological perspectives of SFM in Nepal. Their C&I parameters follow either the standards in Forest Stewardship Council (FSC) system or the former Pan European Forest Certification system and now the Programme for Endorsement of Forest Certification (PEFC). These systems are primarily intended for certification of forest management at FMU level, mostly for community-managed portion of the national forests and also for the certification of sustainably produced NTFP for trade.

Therefore, after a thorough review of and taking into consideration the relevant parameters of past FMU level C&I development initiatives in the country, an effort was made to identify appropriate principles, criteria and indicators for the certification of sustainably produced woodfuel for trade. The process that guided identification of the principles, criteria and indicators is shown through a schematic diagram in Figure 9.

Figure 9. Schematic diagram of the C&I identification process



Principles, criteria and indicators for sustainable management of woodfuel resources

Six principles, 24 criteria and 84 indicators have been identified for initiating sustainable management of the productive national forests under public domain including government managed forests and forest plantations, as well as CFs. The long-term sustainability of these important woodfuels supply sources, for both traded and locally consumed woodfuels, including fuelwood and charcoal, could not be ensured unless and until the country moves towards forest certification. This means, for promoting SFM. These principles, criteria and indicators have been suggested for certification of the sustainable woodfuel production systems and the trade of certified woodfuels being managed in the public sector[§]. One additional principle, four criteria and 12 indicators have been suggested for consideration exclusively for promoting the production and trade of certified charcoal. These parameters are expected to enhance the charcoal production efficiency as well as to contribute to the social, economic and environmental betterments, both locally and globally. But for the certification of woodfuels produced from private sources, primarily from private forests and from trees on private and non- forest lands (or TOF), a separate monitoring mechanism based on the product tracking and transformation process under the chain of custody certification method has been suggested for consideration.

PRINCIPLE 1: POLICY, PLANNING AND INSTITUTIONAL FRAMEWORK IS IN LINE WITH NATIONAL AND INTERNATIONAL LAWS AND CONDUCIVE TO SUSTAINABLE PRODUCTION OF WOOD, WOODFUELS AND NTFP FOR TRADE.

C.1.1 Policy formulation is carried out in a participatory manner.

Indicators:

- *Existence of mechanisms for enhancing participation in policy formulation.*
- *Existence of a multi-sector forum at vertical level (national, district, and local level).*
- *Representation and participation of stakeholders (FUG, FECOFUN, DDC, VDC, NGOs, etc) in forum meetings (records and minutes of meetings).*
- *Regularity of meetings, discussions and other interaction in forums (records).*

C.1.2 Existence of non-contradictory rules and regulations that are in line with national and international laws and promote the production of woodfuels for trade.

Indicators:

- *Forestry policy, rules and regulations acknowledge the international conventions such as CITES, CBS, UNFCCC, etc.*
- *Government directives and departmental circulars do not contradict with the provisions of forest acts and rules and endorse production of woodfuels for trade.*

C.1.3 Non-forestry policies (i.e. energy, environment, agriculture sector policies) do not distort commercial production of woodfuels for trade.

Indicators:

- *Absence of distorting policies in relevant sectors that discourage the production of woodfuels for trade, including export.*
- *Existence of subsidies on imported commercial fuels (fossil fuels).*
- *Alternative energy promotion policy does not undermine the importance of woodfuels for both traditional and modern energy applications with payment of set royalty fees, taxes and other charges required under the prevailing law.*

C.1.4 Legal provisions do not restrict tree growing/raising, planting in private, community and institutional lands under multiple objectives, including harvesting of mature trees (at rotation age) for the production of woodfuels for trade.

[§] Includes all types of natural forests under public domain, including forests and forest plantations managed by the government, local communities, forest leases and others.

Indicators:

- *Acknowledgement of tree ownership right of private land owners, plantation developers, forest lease, FUGs, etc for the trees and forest products grown/raised or planted by them on lands that are legally owned or entrusted for management to them.*
- *Filing of a number of complaints or court cases against the government organizations claiming ownership of trees, private forests and/or forest products declared restricted for harvesting and/or trade from lands and forests owned/managed by individuals, communities or institutions.*
- *Land use policy supports commercial growing/planting of trees and forests, including captive and dedicated woodfuel plantations on lands outside of the forestry sector.*
- *Recognition of indigenous practices of local people that do not hinder sustainable forest management for socio-economic reasons.*

C.1.5 Effective structure is in place for the promotion of private forestry and integration of trees into the farming and landscape systems.

Indicators:

- *Effective central and local level institutions for supporting commercial production of woodfuels from all natural sources, including private forests and TOF.*
- *Provision of support and services to individuals, institutions and agencies involved in commercial production of woodfuels in private non-forest lands for trade.*
- *Absence of overlap/duplication of responsibilities between different institutions.*
- *Existence of inter-sectoral coordination mechanisms for relevant institutions in forestry, agriculture and energy sectors.*

C.1.6 Boundaries of the public wood energy resources are known, clear and respected.

Indicators:

- *Local users and other stakeholders recognize and respect the boundaries of public wood energy resources (existence of boundary markers and conditions).*
- *No evidence of forest encroachment (visual observation and records).*

PRINCIPLE 2: CONSERVATION OF BIODIVERSITY AND MAINTENANCE OF ECOSYSTEM INTEGRITY IN THE PROCESS OF FOREST RESOURCE MANAGEMENT UNDER THE PUBLIC DOMAIN.

C.2.1 Conservation of biodiversity, including natural growth and artificial regeneration in managed national production forests, community forests, leasehold forests, buffer-zone community forests, etc.

Indicators:

- *Landscape pattern is maintained (information on vegetation type etc).*
- *Diversity of habitat is maintained (vertical structure of the forest and size class distribution of tree species, etc).*
- *Species richness/diversity of selected groups is maintained (listing of trees, herbs, birds, mammals and identification of rare and endangered species).*
- *Population size and structures of selected plant species do not show significant change (due to lack of proper management or overexploitation for wood fuel).*

- *Population size and density of selected plant species are estimated (during forest management plan preparation) and maintained (through appropriate management prescriptions).*

C.2.2 Ecosystem function is maintained.

Indicators:

- *Ecologically sensitive areas (buffer-zone along water courses) and other ecologically important areas are identified and protected with appropriate measures.*
- *Erosion and landslides are minimized (sensitive areas identified, appropriate control measure applied).*

PRINCIPLE 3: FOREST (WOOD ENERGY) RESOURCE MANAGEMENT INCREASES BENEFITS THROUGH BETTER FOREST MANAGEMENT.

C.3.1 Effective local management is in place for maintaining and assessing the forest (wood energy) resources.

Indicators:

- *Ownership and use rights to resources are clear and respected.*
- *Rules and norms of resources use are successfully enforced and monitored (existence of rules and norms, patrolling, incidences of violation of rules, number of forest offence cases registered, etc).*
- *Effective and accepted conflict management mechanisms are in place (number of cases resolved).*
- *Access to forest (wood energy) resources is perceived locally to be fair (deprived and poor users get fair concession, access to woodfuel and NTFP, evidence of discussion in meetings on access to resources, attendance of gender, class, caste, and ethnicity in meetings).*
- *Local people feel secure about their access to forest resources, including woodfuels.*

C.3.2 Stakeholders get equitable share from the benefits of forest (wood energy) resource management.

Indicators:

- *Mechanisms for equitable benefit sharing are developed and implemented (local people express satisfaction on the benefits received).*
- *Employment opportunities exist for poor and deprived users (number of such people involved in carpentry works, livestock raring, fuelwood collection for trade, charcoal making and other income raising activities).*

C.3.3 All production forests under different systems of management are considered as means of livelihood by the poor and deprived group of people (including ethnicity, individuals and women) as long as their actions do not go against the spirit of SFM.

Indicators:

- *The above people invest significant amount of time and efforts in wood energy resource management.*
- *Destruction of natural resources by the local people is rare.*

- *Maximum utilization of the productive national forests (all types) by local forestry stakeholders.*

PRINCIPLE 4: CONCERNED STAKEHOLDERS HAVE ACKNOWLEDGED RIGHTS AND MEANS TO MANAGE FORESTS COOPERATIVELY AND EQUITABLY

(*Additional principle applicable solely for FUG managed community forests, leasehold forests and buffer-zone community forests*)

C.4.1 Forest Users Groups are institutionally developed.

Indicators:

- *Users and committee members are fully aware of their rights and responsibilities and perform accordingly (aware of functions, perform assigned role, participate in discussions, acknowledge the issues of gender, deprived and poor).*
- *Effective leadership is developed within community (evidence of mechanism for leadership transfer).*
- *Documentation system is well maintained.*
- *Funds are managed in a transparent way and are properly utilized (existence of financial record, accessibility of financial records, activities in which the fund was spent, misuse of fund, etc).*
- *Information flow to members is maintained (evidence of information exchange between FUG members, awareness of FUG members, etc).*
- *Mechanisms for shared learning exist (events and mechanisms for sharing of knowledge and lessons learnt from training, observation tours between FUG members).*

C.4.2 Effective two-way communication related to forest resource management exists among stakeholders.

Indicators:

- *Local stakeholders meet and interact with satisfactory frequency, representation of local diversity and quality of interaction (regularity of and participation of different class, castes, gender and ethnicity in meetings, no evidence domination by certain individuals or groups).*
- *Stakeholders' contributions are respected and valued.*

C.4.3 Local stakeholders have detailed, reciprocal knowledge pertaining to forest resources use as well as forest management plans prior to implementation.

Indicators:

- *Plans/maps showing integration of uses by different stakeholders exist.*
- *Updated plans, baseline information on socioeconomic conditions of the people, forest conditions and maps are widely available to stakeholders.*
- *FUG and Forest User Committee (FUC) recognize the legitimate interests and rights of other stakeholders.*
- *Management of woodfuel and NTFP reflect the interests and rights of local stakeholders.*
- *Stakeholders are aware of related community forestry acts, regulations, and guidelines.*

C.4.4 Agreement exists on rights and responsibilities of relevant stakeholders

Indicators:

- *FUGs make agreements with relevant stakeholders in forests and forest resources related activities, including woodfuel distribution systems.*
- *Effective conflict resolution mechanism in place (conflict remains at acceptable level to stakeholders).*

PRINCIPLE 5: THE RELATIONSHIP BETWEEN FORES MANAGEMENT, ENVIRONMENT, AND LOCAL CULTURE IS ACKNOWLEDGED BY RELATED STAKEHOLDERS.

C.5.1 Human activities and the environmental conditions are in balance.

Indicators:

- *Environmental conditions affected by human activities are stable or improving.*
- *There is a balance between forest resources and population growth/migration.*

C.5.2 Relationship between human culture and forest management is recognized.

Indicators:

- *Local stakeholders can describe the relationship between human culture and forest management*
- *Forest Working Plan/Operational Plan reflects local human culture*
- *Absence of activities that disintegrate human culture.*

C.5.3 Institutionalization of formal and informal education on forest (wood energy) resource management.

Indicators:

- *Increased awareness on forests and forest resource management.*
- *Establishment of mechanisms to enhance people's awareness on wood energy resource management (training and education programmes/materials).*

PRINCIPLE 6: YIELD AND QUALITY OF DESIRED FORESTRY GOODS AND SERVICES ARE SUSTAINABLE.

C.6.1 Forest management unit is implemented on the basis of legal title on the land, scientific Forest Working/Operational Plan and recognized customary rights.

Indicators:

- *Forest management takes place based on scientific basis and in consultation with the public in the case of government-managed national forests and in written agreements between the government and FUGs or private leases in the case of CF and LHF.*
- *Information on the identity, location and population of all indigenous and traditional people living in the vicinity of the government-managed forests and community forests and their customary rights exist.*
- *DFOs, FUGs and other concerned institutions have evidence and map about indigenous and traditional people, their territories and rights.*

C.6.2 Management plans is detailed and clearly documented.

Indicators:

- *Management objectives (both long- and short-term) are clearly stated reflecting the condition of forest, expressed public interest of the forestry goods and services and the local forest users needs.*
- *Forest Working Plan/Operation Plan is comprehensive (identifies boundaries, provide inventory of resources, protection, includes management and utilization plans, biodiversity hot spots and cultural and conservation areas, mechanism for handling emergency situations, etc).*
- *Appropriate involvement of stakeholders in management (including Forest Working/Operational Plan preparations) and takes into account all components and functions of the forest (i.e. timber, woodfuel, NTFP etc).*
- *Yield regulation by area and/or volume is prescribed in Forest Working/Operational Plan (allowable cuts, minimum exploitable diameter, number of trees or total volume to be harvested per year etc).*
- *Silvicultural systems are prescribed and are appropriate to forest types and produce growth (management practices, species level inventory, assessment of growth, planting plan and planting stocks).*
- *Prescribed harvesting systems and equipment match the condition of forest in order to reduce impact.*
- *Forest Working/Operational Plan is periodically revised and approved by appropriate authority.*
- *Programs and estimated costs of forest management activities are included in Working/Operational Plan on a priority basis.*
- *Programs and estimated costs of community development are included in Forest Working/Operational Plan on a priority basis.*

C.6.3 Implementation of Forest Working/Operational Plan is effective.

Indicators:

- *Management as defined in the objectives.*
- *Implementation of Operational Plan as per the prescriptions, including record keeping.*
- *Low residual stand damage (skilled labours, sound logging plans, etc).*
- *Rehabilitation of degraded and impacted forest.*
- *Absence of significant off-site impacts.*
- *System of forest products harvesting and transformation are efficient.*

C.6.4 Effective monitoring system is implemented.

Indicators:

- *Mechanisms for monitoring and evaluation are clearly described in the Forest Working/Operational Plan, including chain of custody monitoring of products.*
- *Documentation and record of all forest management and forest activities are kept in forms that enable monitoring, also for product tracking during transportation and transformation.*
- *Forest trial plots are established and monitored regularly.*

C.6.5 Costs and benefits from all types of national forests are properly accounted for, distributed and shared among relevant stakeholders.

Indicators:

- *Mechanisms for sale and/or equitable distribution of forest products (including woodfuels) to relevant stakeholders are clearly described in the Forest Working/Operational Plan.*
- *Re-investment of the benefits from forestry management for forestry development.*

C.6.6 Promotion of user and environment-friendly wood energy technologies, government initiatives of R&D on woody and non-woody biomass-based modern energy applications.

Indicators:

- *List of environment-friendly modern wood energy technologies relevant to Nepal.*
- *Priority R&D areas in modern wood energy applications (i.e. technologies and end uses).*
- *Priority R&D areas in non-wood biomass based modern energy applications (i.e. technologies and end uses).*

Additional principle, criteria and indicators for sustainable charcoal production

PRINCIPLE 7: TECHNOLOGIES USED FOR CHARCOAL MAKING ARE EFFICIENT (PRODUCE HIGHER OUTPUT), NON-HAZARDOUS TO CHARCOAL MAKERS AND LEAST POLLUTING TO THE ENVIRONMENT.

C.7.1 Fuelwood supply sources are sustainable and the supply is legal.

Indicators:

- *Supply sources (national forests) are under sustainable management.*
- *Fuelwood procurement system for charcoal making is legal, pays full royalty fees, and taxes etc., on fuelwood harvested/collected (from national forests).*
- *Record of every batch of fuelwood purchase, charcoal production and trade maintained, including number of people employed by gender and ethnic group.*

C.7.2 Inventory of charcoal making technologies currently in use, assessment of their average efficiency and selection of efficient models.

Indicators:

- *List of prevailing charcoal making technologies.*
- *Average efficiency of common technologies assessed (record/report, fuelwood input to charcoal output ratio).*
- *List of tested efficient models for promotion.*

C.7.3 Assessment of health and the environmental impacts of common charcoal making technologies.

Indicators:

- *Health-related complaint and cost of medication to the charcoal makers, transporters and traders.*
- *Analysis of chemical constituents of the smoke emitted out of the chimney/exhaust pipe of charcoal kilns/pits, including green house gases (GHG) such as carbon dioxide and methane and health damaging emissions (HDE) such as particulates and sulphur dioxide).*

C.7.4 Field-testing, demonstration and extension of efficient charcoal making technology to directly relevant occupational group(s).

Indicators:

- *Different types of models tested and demonstrated in the field.*
- *Selection of accepted models and efficiency.*
- *Extension program for dissemination and training.*
- *Continuation of R&D for further improvement.*

Description of the principles, criteria and indicators

The above sets of principles, criteria and indicators will be suitable for the certification of sustainable fuelwood production from different types of productive national forests and forest plantations. But these will not be applicable to private forests and trees on private and other lands including public and institutional land-based TOF. While identifying suitable parameters for the certification of sustainable woodfuel production systems and the trade in certified woodfuels, the past initiatives of criteria and indicators development at both national and international levels were taken into consideration. A straight forward set of C&I could not be conceived exclusively for the certification of sustainable woodfuel production for trade, as woodfuels in most cases were not the main (or final) product but produced as residues or by-products of forest resource management, during tree harvesting, thinning, pruning etc.

Similarly, no specific set of principles, criteria and indicators could be suggested/ prescribed for the certification of woodfuels produced from private forests and TOF on different types of lands owned and managed by non-forestry sectors. For these additional sources of woodfuel production, as well as for certification of the production systems of indirect woodfuels and recovered woodfuels, the only logical method that seems suitable for adoption for certification would be the chain of custody monitoring during transportation and transformation. For certification of the fuelwood supplied for charcoal making from government managed forests and CF, the above set of principles, criteria and indicators could be applied. But for certification of the sustainable charcoal production systems and trade in certified charcoal a combined system of monitoring will be needed to monitor the charcoal making practices (transformation process: technology, conversion ratio, etc), as well as any misdoings during transportation and trade.

As far as possible, attempt was made to bring the suggested principles, criteria and indicators within the broad framework suggested by ITTO-FAO (during the workshop on “Development of National-Level Criteria and Indicators for the Sustainable Management of Dry Forests of Asia”, in Bhopal, India in 1999) in Appendix 1, and the reformulate set of C&I by the participants of that workshop in Appendix 2.

In fact, the suggested principle 1 reflects the concerns of C.7 in Annex 1a and C.8 in Annex 1b. Similarly, principle 2 takes care of the concerns of C.2 in Annex 1a and C.2 and C.3 in Annex 1 b. Both of these principles will be applicable at national and FMU levels. Principle 3 incorporates the concerns of C.6 in Annex 1a and C.7 in Annex 1b, which will be relevant for application at FMU level. The next one, principle 4 takes care of the concerns of C.6 and C.7 in Annex 1a and C.7and C.8 in Annex b, at FMU level. Principle 5 reflects the concerns of C.5 in Annex 1a and C.4 and C.7 in Annex 1b, also at FMU level. The last one, principle 6 incorporates the concerns of C.C.3 and C.3 in Annex 1a and C.5 in Annex 1b. The additional principle suggested for sustainable charcoal production reflects the concern of C.5 in Annex 1a and C.4 in Annex 1b.

Besides, the suggested principles, criteria and indicators are also in line with the six fundamental principles and 24 criteria and 83 indicators developed earlier (by CIFOR in 1999) but not yet approved by the government for implementation, for certification of sustainably managed community forests and NTFP trade. The six principles include: (a) policy, planning and institutional framework, (b) maintenance of ecosystem integrity, (c) increased benefits to local communities from better forest management, (d) rights and means to cooperative and equitable management, e) relationship between forest, environment and local culture, and (f) sustainable production of goods and services.

Besides the managed national forests under public domain, the other sources of direct woodfuels production are private forests and TOF, but these forests and TOF could not be included for the certification of specific products as the long-term sustainability of production system itself remained under question. Therefore, these production systems were found not possible to cover through the standard set of principles, criteria and indicators suggested for the certification of the production sources of direct woodfuels. Similarly, certification of indirect woodfuels and recovered woodfuels produced in different shapes and sizes outside of forest areas, mostly in wood-industries and non-forest lands were also found not possible to include for certification under the straight forward principles, criteria and indicators of forest certification.

Therefore, these products would require monitoring by following the product tracking and transformation process under the chain of custody certification method. The primary objective of such monitoring system would be to avoid addition of the illegally harvested direct woodfuels from national forests during transportation and transformation for trade.

The certification of sustainable charcoal production for trade will be further complicated, as it has to look also into the social, economic and environmental aspects of the common technologies adopted for charcoal making in Nepal. Besides, identification of main fuelwood production sources (nature, wood industries and society); production methods (direct, indirect and recovered woodfuels) for charcoal making; assessment of average recovery ratio between fuelwood to charcoal (between average weight of air dry fuelwood as input and average weight of charcoal as output); specific charcoal making technologies; and information about transportation and trade in charcoal, make the study more difficult to present a comprehensive scenario. As such information is lacking and this study was not expected to generate primary data, therefore attempt was made to explore and analyze the prevailing situation based on whatever information was available in different sources.

Since charcoal has not been the main energy, its consumption has been restricted to specific end uses; the question of certification of charcoal itself looks irrelevant in the case of Nepal. However, whatever amount of charcoal is being produced and consumed in the country, it would still be worthwhile to monitor through tracking of product transformation and trade under the chain of custody certification, primarily for promoting SFM in different types of national forests. Smith, K.R. *et al.* (1998)

have studied the airborne emissions from charcoal-making kilns that are commonly used in the developing world. Their study was conducted in Thailand, which took into consideration five types of charcoal-making kilns for testing of their emission factors, for greenhouses gases such as carbon dioxide, methane and nitrous oxide, for indirect greenhouse gases like carbon monoxide and total non-methane hydrocarbons, as well as for total suspended particulates. Based on their study findings, one additional principal, four criteria and 12 indicators have been suggested for consideration under this study for certification of the sustainable charcoal production and trade of certified charcoal, primarily to minimize the health and environment related adverse impacts of charcoal making.

Chain of custody monitoring criteria for fuelwood

Direct woodfuels from private supply sources and TOF

In the case of direct woodfuels produced from private sources such as private forests and TOF, it would not be possible to apply standard set of principles, criteria and indicators of SFM suggested for national forests. Due reasons are already explained in preceding paragraphs. However, these alternative fuelwood supply sources are crucial in meeting the market demands of traded woodfuels. Besides, it will be necessary to ensure an unhindered flow of this complementary supply in the market that will help relieve the pressure off the national forests for illegal fuelwood harvesting leading to deforestation. Nevertheless, some kinds of monitoring system could be devised and implemented for avoiding illegal collection and/or mixing of illegally harvested/stolen woodfuels from the national forests when the fuelwood from private sources become necessary to transport to distant places for trade in commercial markets.

Monitoring parameters:

- Notification/application to the concerned local authority (i.e. DFO, DDC, VDC, etc) informing/seeking permission for harvesting, including details such as species, number and size of trees to be harvested for trade.
- Verification of the number of trees applied for felling, estimation of volume of wood and direct woodfuels that are likely to be produced by tree species.
- Public notification of the estimated amount of wood and fuelwood that would be harvested by particular individuals or institutions for own use or for the purpose of trade (posting information and/or maintaining records in concerned offices such as DFO, DDC and other local level public institutions/agencies including VDC, FUG, NGOs and schools).
- Recording of actual amount of construction wood and woodfuels harvested by species and source.
- Informing the offices of relevant local agencies and other stakeholders about the amount of wood and woodfuels approved and authorized for transportation and trade.
- Maintenance of records of tax or royalty amount, if subjected to any, in relevant offices.
- Issuance of formal permit and informing relevant checkpoints about total amount harvested by product type and by species in each consignment during transportation and the depot where the products are to be transported for sale.
- Every depot that sells privately produced woodfuels must maintain information on record showing the sources of origin, total volume by species procured from particular producers, whole-sellers, transporters, etc.

- The checkpoints en-route must also compile information showing the sources of origin (including place and name of producer) total volume by species for particular producers, transporters and the destination of each consignment

Indirect/recovered woodfuels from industries and society

Currently, no system exists for monitoring the indirect woodfuels production from forest industries. Similar is the situation regarding the recovered woodfuels produced by the society. In the case of indirect woodfuels produced as a by-product in wood-industry, as long as the materials are consumed for in-house energy supply by the producing industry itself, then institutionalization of a simple record-keeping system that indicates the quantity of such woodfuels produced and consumed by commodity type would be desirable for monitoring of production and consumption. Besides, submission of a summary report of indirect woodfuels production and consumption by commodity type and quantity by specific industry to relevant local level offices under the ministry of industry and MFSC, as well as the concerned DDC seems adequate.

If the commodity is also to be transported from the production source to other place for trade, either for straight-forward use as fuel or for transforming into other energy forms, then, institutionalization of a record-keeping system at the production source, as well as in forestry check-points along the transportation route and at the delivery points or consumption centre, would be desirable. Such record-keeping system could assist in monitoring of the production of indirect woodfuels, if trade in certified product becomes the objective to ensure SFM in the future. But, it would be difficult even if desired to certify the scattered production of recovered woodfuels, which in most cases, is consumed within the vicinity of production sources, mostly in rural households and by the poor in urban areas. Whenever it requires transportation to some market centres, it would be advisable to maintain at least some kinds of record in local level offices of the concerned line ministries that show the quantity, source of origin and the identity of traders and transporters.

Chain of custody monitoring criteria for charcoal

Charcoal is not a main fuel in the domestic sector and it is currently used mostly for specific end uses. Still there have been numerous actors playing specific roles in the production and trade of charcoal, whether legally or illegally, in the country. Therefore, by following the stages considered for this case study in Figure 3, at least four different phases have been identified from charcoal making to charcoal trading phases. Which means, the chain of custody monitoring system for the certification of sustainable charcoal production and trade of certified charcoal if at all intended for introduction in the future, would be desirable to include all phases of charcoaling. This means it would include standing tree procurement to fuelwood preparation (including harvesting/collection/preparation) phase; transportation of fuelwood from production sources to loading of charcoal kilns/pits for transformation (including unloading and packing) phase; transportation of charcoal to consumption points or markets (including loading, unloading) phase; and, trading (selling) phase.

Fuelwood procurement phase

The important concern at this phase will be to ascertain the fuelwood supply sources for charcoal making, primarily to ensure that it came from managed sources and through legal means. The principles, criteria and indicators suggested for certification of forest and direct woodfuels production from different types of national forests and forest plantations will also be suitable for certification of sustainable fuelwood supply for charcoal making for trade. But these variables will not be relevant for the indirect and recovered woodfuels used for charcoal making and separate criteria under the chain of custody certification method would be needed to apply, following the suggestions made under relevant paragraph of section 8.3.1, above.

Transformation phase

Monitoring of the origin and methods of procurement of fuelwood used for charcoal making would be crucial at this phase, as charcoal makers could easily add illegally acquired fuelwood to their legally acquired fuelwood from adjoining forests. Such possibilities would be more if the charcoal making sites remain close to or within the boundary of national forests and forests plantations. So, the concerned agencies (DFOs and FUGs) could think of institutionalization of a simple monitoring system that would help identify the sources of fuelwood supply for charcoal making, primarily to discourage mixing of illegally procured fuelwood. Besides, determination of average ratios of fuelwood input to charcoal output by kiln type would be desirable for the chain of custody certification system for traded charcoal.

In addition, the following parameters for monitoring could be considered:

- Discourage the use of illegally produced fuelwood for charcoal making.
- Discourage the use of illegally produced charcoal.
- Promote the use of efficient charcoal making devices instead of traditional dug-pits.
- Promote the utilization of all sizes of available fuelwood for charcoaling.

Transportation phase

So far, no agency has registered for transporting charcoal in the country. As the production and trade is in the informal sector, mostly as an illegal activity, its transportation and trade is therefore not done openly. However, if FUGs are allowed to use the surplus fuelwood available from CF for charcoal making for trade, then they may consider the following parameters for monitoring in order to promote SFM.

- Issue certificate of legal charcoal production from managed CF, indicating fuelwood supply sources, amount of charcoal produced for trade etc.
- Maintain record and make it transparent to interested stakeholders.
- Issue permit for transportation and trade, indicating origin, amount etc.

Trading (selling) phase

Currently, no formal agency or company exists for trade in charcoal. The present volume of trade and the size of charcoal market remain unknown. It would be therefore difficult, if at all possible to monitor its trade in a closed market, often sold in small amount (about 1–2 kg) in dark poly bags to hide the content inside. If FUGs would like to get involved in charcoal production and trade in the future, then they could think of the following:

- Register local traders and their annual volume and value of charcoal trade.
- Issue certificate indicating registered charcoal traders for particular FUG.
- Institutionalize record-keeping systems at both ends, in production sites as well as in trading places.
- Discourage registered charcoal traders to buy and sell illegally produced charcoal.

REVIEW OF FINDINGS

In the context of Nepal, the wood energy resources for production of direct woodfuels are national forests under different management systems, including natural growths as well as forest plantations. It was noted that direct woodfuels derived from national forests, including government-managed forests and CF for trade, remained in the same order of magnitude as that obtained and sold from the TOF (including private forests). These woodfuels were derived mostly in the form of by-products of forest logging (i.e. lops and tops, deformed and decayed wood) and woody residues produced during implementation of forest management prescriptions (i.e. pruning, thinning) in national forests and forest plantations.

Therefore production of direct woodfuels from these sources cannot be treated as an independent activity and must be treated as part and parcel of implementation of the management prescriptions under approved Forest Working/Operation Plans of these forests. Such plans in principle, must take into consideration the social, economic and environmental perspectives at national and FMU levels; maintain the record of product harvesting, product flow and financial transactions; develop criteria and indicators for the certification of SFM.

Modern application of bioenergy is still insignificant. The future development scope of modern bioenergy also remains not adequately known or acknowledged. However, its use in specific sector (i.e. domestic and transport sectors) has been talked about as a possibility for the future. Therefore, production of woody biomass for trade as a marketable commodity for modern bioenergy production remains still uncertain. As the imported fossil fuels have not been a part of the national programme in the energy sector and its management is done by the Ministry of Commerce and Supplies, primarily for meeting the energy needs in the transport and industry sectors, there seems no coordination between these two sectors. Besides, the forestry sector which is the important contributor of primary energy for meeting the cooking and heating energy needs in the domestic sector seems to be completely ignored while planning a long-term strategy in the energy sector. Although the country is endowed with enormous hydropower generation potential, the amount of power harnessed so far has remained only limited. Therefore its use for cooking and heating in the domestic sector remains only as a distant possibility.

In many areas of Nepal, head loading of woodfuel and charcoal making for trade do act as a survival safety net to the rural poor and under-privileged members of the society. But such acts are generally illegal, despite the fact that markets for trade of locally produced woodfuels clearly exist. That is why the people dare risk to benefit from this opportunity. In Pokhara, Nepal a shop owner reported having made a significant profit from illegal charcoal making and trade within few months only (RWEDP, 1991).

Most forests under the government management lacked satisfactory forest working or operation plans for their sustainable management. Currently, the tree harvesting system is based mainly on felling or collection of dead and dying trees. Besides, the allocated development fund in the forestry sector was also considered insufficient for implementing scientific forest management plans.

The average size of private land-holdings is very small. It is considered insufficient for sustaining even the livelihoods of the farming families, which limit the scope for additional tree planting on private lands. In some areas, the current contribution of private sources in traded wood and fuelwood supply is significant, but there is no central system of record-keeping of the total volume and value of traded fuelwood from these sources.

Although, the prevailing law of the land does not restrict or limit production and trade of legally allowed forestry and agricultural crops, including specified wild animal raring for own consumption and trade, transportation and trade of certain crops and tree products (including fuelwood and charcoal) for trade outside of the production source (from the village of production to other villages within the district or to commercial markets) call for observance of the specified procedures (i.e. land and tree ownership verification, approval of the number and species of the trees to be felled, permit for tree felling, conversion, transportation for movement and/or trade, verification of the volume of production by product type and species) under the prevailing legislation. Therefore, whatever new initiatives are to be introduced for promoting the certification of privately produced direct woodfuels for trade, the mechanism must be within the above stated limitations, where the chain of custody certification method seems the likely mechanism.

Khanal (1998) identifies transportation as a major constraint on the trade of woodfuels in this mountainous country. The prevailing high transportation costs and low sale prices both posed hurdles to transport woodfuels from areas of surplus to deficit areas for trade. It suggests simplifying the woodfuel trade process and leaving the task to the private entrepreneurs and FUGs. For enhancing the production and trade of woodfuel related products, RWEDP (2000) categorically suggests to simplify the present cumbersome procedures of private tree harvesting for trade. It also suggests for initiating a special fuelwood plantation programme for private lands, as well as to offer training and extension programme focusing on the fast growing, high yielding fuelwood species.

The marketing chain of commercial woodfuels obtained through informal or illegal collection (primarily from national forests) is reported different from the legally obtained supplies. The prevailing administrative and legislative hurdles seem affecting the registration of private forests, as well as for harvesting, processing and transportation of wood and fuelwood from the private sources for trade.

It was noted that the prevailing rules and regulations governing land ownership and holdings, tree tenure, tree planting and harvesting in privately owned and/or community-managed lands often adversely affected the woodfuel production in non-forest lands as well as the participation and investment by the people.

It seems suggestion was already made some time ago to encourage the fairly large-size private land owners in commercial tree plantations, but without the absence of any direct or indirect incentive offer to the private land owners progress to date has been only limited. Besides, the frequently changing policies and staff placement seem to hamper the technical backstopping of forestry development in the field. Currently, there is no plantation development scheme to promote the fast growing tree species, neither under the government nor under the private sector. Therefore, introduction of some kind of incentive systems for promoting private tree plantations, including waiver on land revenue, tax subsidy, buy-back guarantee of plantation wood, simplification of felling and transportation rules, provision of technical support, etc was proposed during various occasions.

The volume of fuelwood traded from community forests is not significant as protection has been their main objective until recently. The production has remained localized; however the production could be enhanced through intensive management, including simplification of legal provisions to encourage the FUGs for initiating trade in all types of surplus forest products (including woodfuel) outside of their respective districts.

RWEDP (2000) suggests identifying the village development committees (VDCs) as possible local level agencies for maintaining the wood and woodfuel production data of private lands for overcoming the present data gap. The woodfuel flow system was characterized by frequent policy changes, limited access to the private sector, lack of adequate networks, uncertain supplies, cumbersome harvesting and transportation procedures, etc. It was reported that due to unemployment or underemployment, the rural people misused the one head-load of fuelwood for self-use privilege by selling the collected fuelwood under this privilege to the middle persons for some cash earnings.

Most of the charcoal traded in local markets was illegally made in government-managed forests. Legal provisions and operational guidelines did not exist for managing the production and marketing of charcoal from different sources for commercial trade. Recently, production of charred biomass briquettes in the form of Beehive briquettes and development of cook stoves for using these briquettes are being promoted under different development projects. The use of thorny bush like *Banmara (Eupatorium sp)* that has so far been considered as a menace to the forest posing fire hazard has been successfully used for converting into the Beehive briquettes. Beside, residues of crops in different sizes and forms have also been used for making charred Beehive briquettes, which have been recognized as a potential substitute to imported kerosene use in the mountainous areas.

The preferred species for fuelwood and charcoal making in Pokhara region calls for adequate consideration for their conservation as the tree species of higher preference is likely to be over exploited in the absence of scientific forest management plans that governed fuelwood harvest in already handed-over CF and other government forests in the vicinity. It would be essential to take into consideration the maintenance of species richness and species diversity in the forest management plan of the area for maintaining their overall biological diversity.

CONCLUSIONS AND RECOMMENDATIONS

This study suggests that the term “certification” should not be viewed solely as certification of the tree products such as timber, woodfuels or NTFP, but certification of overall management of the forest. And it means, until and unless forests are managed according to the principles of SFM that qualify for certification of forest management system, certification of only the products of forests such as woodfuel will not be possible.

Certification of the sustainable woodfuel production systems and the trade of certified woodfuel, primarily the direct woodfuels produced as by-products of forest harvesting, thinning or pruning, from government-managed national forests and forest plantations, as well as from FUG-managed community forests, seems possible to consider at the FMU level. But it will require a simultaneous certification of both production sources and the production process, which means the certification of forests (or wood energy resources) for initiation of sustainable management and the certification of important forest products, including direct woodfuels for its sustainable production for trade in local markets or for export.

In this regard the principles, criteria and indicators identified for certification of community forest management and the trade of certified NTFP from managed CF under CIFOR initiative in 1999 seems reasonable to consider as guide for identification of principles, criteria and indicators for the certification of sustainable woodfuels production for trade. However, these will be relevant only to government-managed national forests, forest plantations and CF and not to private forests and TOF, because of their uncertainty of existence in the long-term. Therefore, certification of private forests and TOF, including certification of sustainable production of the wood and non-wood products, including direct woodfuels from these sources for trade, pose additional challenges. Although these sources contribute numerous goods and services to the society, including forest products, aesthetic and recreational benefits, but these have not been fully acknowledged. Besides, sustainable management of private forests and TOF is more complex. For these resources, the C&I set proposed during the Bhopal workshop would neither be suitable nor practical to implement in totality for certification of sustainable woodfuel production for trade in the Nepalese context. Therefore, the present study has considered it unreasonable to attempt to recommend C&I for certification of these non-government sector owned/managed forestry (wood energy) resources. The suggested certification strategy is solely for direct woodfuels from government and community managed national forests and forest plantations, which is based on the premises of forest certification as a short-term action for initiating SFM in Nepal.

The standards (parameters) to be applied for certification of government-managed national forests and forest plantations and CF, and for certification of specific forest products produced from these sources, depend solely on the criteria and indicators (C&I) that will be developed and applied at the national and FMU levels. As achievement of SFM is a long-term commitment and takes considerable period of time, no productive function of forests can be halted indefinitely. Therefore, a rational strategy would be first to identify the parameters of SFM within the country, including principles of forest management, and criteria and indicators for monitoring the move towards it. But these parameters should incorporate all common elements of C&I developed at the regional and international levels for promoting SFM globally.

The principles, criteria and indicators developed for the certification of government-managed national forests and forest plantations and CF and for the certification of sustainable production of direct woodfuels produced from these sources for trade, would not be applicable for the certification of direct woodfuels produced from the private forests and TOF due to already stated reasons. Similarly, the stated principles, criteria and indicators would not be suitable for the certification of sustainable production of indirect woodfuels and recovered woodfuels from all sources, and also for the certification sustainable charcoal production for promoting the trade of certified charcoal. In order to certify these woodfuels for trade, a separate "chain of custody" monitoring system has been proposed for adoption. Under this process the production and flow of these products will be tracked during transformation and transportation.

As no country could afford to stop its prescribed forest harvesting operations until a full fledged SFM system is in place, all routine forestry operations like thinning, pruning and logging; collection of woodfuel and non-timber forest products (NTFP) for trade, etc must continue side by side with the activities of SFM institutionalization. However, institutionalization of SFM practices in all productive national forests, forest plantations and CF demand a long-term commitment from directly relevant stakeholders, including researchers, academicians and individuals involved in the establishment, management, flow and trade of all types of forestry goods and services.

Experience from past initiatives within the country suggests that a cheap, practical, simple and feasible means of forest certification of international standard does not yet exist in Nepal. This makes it both difficult and unaffordable to initiate the FSC level of standards prerequisite for all government and community managed forests without outside financial and technical assistance.

So, national standards need to be developed first for sustainable management of important wood energy resources for ensuring sustainable supply of fuelwood and charcoal for trade. The wood energy resources in the case of Nepal are primarily the national production forests and forest plantations under different systems of management in the public domain. Development and institutionalization of national standards of SFM is a cumbersome process, which requires the participation of important stakeholders, as well as a consensus agreement applicable for a long time. But as a stopgap measure, until a full-flagged national forest certification standard is put into implementation, the development of principles, criteria and indicators only for monitoring sustainable production of specific forest products like fuelwood and charcoal from public production sources for trade, seem a reasonable short-term approach. So, in the succeeding paragraph, attempt was made to identify and suggest a set of tentative principles, criteria and indicators for the certification of sustainable woodfuel production systems and the trade of certified woodfuels in Nepal. Only after fulfilment of these prerequisites an accredited certifier could be requested for initiation of forest certification from the point of view of trade in certified woodfuels.

The international certifiers use the generically designed standards of FSC or PEFC so they could be immediately hired for initiating forest certification as and when required, provided financial resources should be no problem, which is rarely so for a developing country like Nepal and also for a least valued product such as woodfuels. A possible alternative to this expensive undertaking will be to develop a flexible set of national certification standards by the country itself. However, the development process must be under a formally established national working group, which includes the representation of important stakeholders. It may take a long time to complete the process.

But to continue production and trade of forest products, including woodfuels, until a full-fledged national standard comes into effect, a proper monitoring system for recording the volume and value of products during production/transformation and transportation would be essential, in order to avoid unwanted mixing or addition of illegally harvested and/or transformed products. This product tracking system must be implemented side-by-side with the principles, criteria and indicators identified for direct woodfuels produced from government- and community-managed forests and forest plantation, for promoting SFM in Nepal.

In order to institutionalize SFM in Nepal, interested stakeholders have recently formed an ad hoc national working group under the umbrella of Nepal Foresters' Association (NFA), which will coordinate the national initiatives of forest certification. The ad hoc national working group was established with representation from relevant stakeholders from GOs, NGOs and private sectors. The primary thrust of this initiative is to devise and test a cheap, affordable and practical forest certification system that would be at par with the FSC standards. In this regard, NFA has so far organized an initiation workshop jointly with the SNV-Nepal (on 20 August 2004) and a national stakeholders' workshop on forest certification (on 24 March 2005). Recently (in September 2006), NFA has been successful to mobilize a nominal amount of financial assistance from the UNDP/GEF Small Grant Programme for carrying out this joint initiative further ahead. Side by side, agreement has been signed with different development partners for development and field-testing of forest certification standards applicable in their area of interest.

So, it is proposed to the ah hoc national working group to consider also the proposed principles, criteria and indicators for the certification of government-managed national forests and forest plantations and CF under this study. Similarly, the additional principle, criteria and indicators, suggested for the certification of sustainable production of direct woodfuels from private forests and TOF; for the certification of indirect and recovered woodfuels from all sources; and, for the certification of sustainable charcoal production for trade from woodfuels acquired under different methods of production, deserve the consideration of ad hoc national working group for implementation in Nepal.

In order to develop the national standards of SFM, it is now high time for Nepal to consider setting up a national authority of forest certification. It would not only help coordinate the initiatives of different actors within the country, but also fulfil the commitment made by the country at various regional and international agencies working for the cause of SFM in the world. After establishment of a national authority and formulation of a set of standard principles, criteria and indicators of SFM, Nepal may also consider applying to relevant international certifying agency for accreditation as a formal forest certifier in Nepal.

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APPENDICES

Appendix 1. Proposed Criteria And Indicators For Sustainable Forests Management In The Region (Bhutan, China, Mongolia And Nepal) Source: FAO-RAP (2000a)

Criteria 1 Extent of forest resources and the conditions

Indicator 1.1 Area and percentage of forests and other wooded (including plantations, agroforestry, shelterbelts) lands to the total land area

Indicator 1.2 Biomass, standing volume, growing stock and carbon storage of forests and other wood lands

Criteria 2 Conservation and enhancement of biological diversity

Indicator 2.1 Ecosystem diversity

2.1.1 Distribution of forest ecosystems (area and percentage of the forest types and other land types)
2.1.2 Areas of forest reserves and protected areas
2.1.3 Area lost annually of forest ecosystem containing endemic species

Indicator 2.2 Species diversity

2.2.1 Number of forest dependent species
2.2.2 The status (rare, endangered, threatened or extinct) of forest dependent species and the change population size of species at risk

Indicator 2.3 Genetic diversity

2.3.1 Number of forest species reduced distinctly in distribution range
2.3.2 Stand amount and area of tree seed orchard and seed reserve for conserving or improving forest genetic resources
2.3.3 Area and percentage of stand by plantations of exotic species

Criteria 3 Maintenance and enhancement of productive functions of forest and other wooded land

Indicator 3.1 Percentage of forest and other wooded lands managed according to an integrated management plan

Indicator 3.2 Total area of forest land and net area for timber production

Indicator 3.3 Area, standing volume and its annual increment of major forest types

Indicator 3.4 Periodical balance between growth and removal of wood products

Indicator 3.5 Managed and sustainable extraction of non-wood forest products (e.g. fodder, seed, fruits, fern, medicinal materials, consumptive wildlife utilization, etc.)

Criteria 4 Maintenance and enhancement of forest ecosystem health and vitality

Indicator 4.1 Area and percentage of forest types affected by diseases, pests, wild and domesticated animals, competition from introduced species

Indicator 4.2 Area and percentage of forest types affected by fire, storm, flood, drought, and wind erosion

Indicator 4.3 Area and percentage of forest types affected by human activities

Criteria 5 Maintenance and enhancement of forest protective and environmental functions

Indicator 5.1 Area and percentage of forests and other wooded lands managed mainly for protection purposes (e.g. for protection and/or rehabilitation of agricultural or range lands, and/or rehabilitation of degraded lands and/or areas prone to desertification and relevant important infrastructure works)

Indicator 5.2 Areas and percentage of forest and other wooded areas managed mainly for the water source conservation, protection of watersheds, river zones and flood control

Indicator 5.3 Area and percentage of forest land with significant soil erosion (different degree)

Indicator 5.4 Area and percentage of farmland above 25 degrees slope converted to forests

Indicator 5.5 Percentage and kilometres of stream in forest watershed in which stream flow and timing has significantly deviated from the historic of variation

Indicator 5.6 Sedimentation for the streams with significant variation from the historic range

Indicator 5.7 Area of sand dunes annually stabilized through tree/shrub planting

Indicator 5.8 Areas and efficiency of trees/shrubs planted in stabilizing sand dunes or rehabilitating eroded hillsides

Indicator 5.9 Effective of plan formulated for managing trees/shrubs planted for desertification control

Criteria 6 Maintenance and enhancement of long-term multiple socio-economic benefits

Indicator 6.1 Indicators for economic benefits

6.1.1 Value of wood products
6.1.2 Value of non-wood forest products
6.1.3 Ecotourism (incl. hunting, recreation)
6.1.4 The output and value from the processing for wood products and non-wood products
6.1.5 Share of forest sector in GNP
6.1.6 Value from biomass energy
6.1.7 Forest sector trade balance
6.1.8 Investment in forests and forestry industries, incl. natural forest conservation, forest recreation and ecotourism
6.1.9 Investment in forest education, research and extension
6.1.10 Degree of recycling of forest products

6.2 Indicators of social benefits

6.2.1 Direct and indirect employment in the forestry sector and forestry sector employment as a proportion of total employment
6.2.2 Degree to which social, cultural and spiritual needs met
6.2.3 Benefits accruing to local communities (with particular emphasis on women and youth)

6.2.4 Contributions to food security

6.2.5 Area and percentage of forest land managed in relation to the total area of forest land to protect the range of cultural, social and spiritual needs and values

Criteria 7 Legal, institutional and policies framework for sustainable forest management

Indicator 7.1 Existence of a national forest policy in harmony with other sectoral policies

Indicator 7.2 Existence of multi-sectoral participation in establishing periodic forest-related planning, assessment, and policy review including cross-sectoral planning and coordination

Indicator 7.3 Clarifies property right, security of tenure, incl. status of length, exclusivity, enforceability, transferability

Indicator 7.4 Provides opportunities for public participation in public policy and decision-making related to forest and public access to information

Indicator 7.5 Existence of a comprehensive legislative and regulatory framework providing, e.g. equitable access to resources, alternative forms of conflict resolution and consideration of land occupancy and cultural right of local populations

Indicator 7.6 Existence of institutional, human and financial capacity to implement the national forest policy, and relevant national and international laws, instruments and regulations

Indicator 7.7 Existence of research and development capacity

Indicator 7.8 Existence of incentives for investments in the forestry

Indicator 7.9 Existence of foundation and institution for forest resource and wild animal resource monitoring

Indicator 7.10 Existence and Implementation of a regional forest ecological compensation system

Appendix 2.Regional Initiative For The Development, Assessment And Measurement Of National-Level Criteria And Indicators For The Management Of Dry Forests In Asia

Criterion 1: Extent of Forest and Tree Cover

- Area of natural and man-made forests
- Area of dense, open and scrub forest
- Area under trees outside forest
- Forest area diverted for non-forestry use
- Extent of encroachment in forest areas

Criterion 2: Maintenance of Ecosystem Health and Vitality

- Extent of natural regeneration
- Extent of secondary forests
- Extent of forest area under
  - *obnoxious weeds &pests and diseases of epidemic proportions*
- Extent of forest area affected by
  - Grazing, fire, storms, floods, droughts ,wind

Criterion 3: Maintenance and Enhancement of Bio-diversity

- Extent of protected areas
- Number of threatened, keystone, flagship and endemic species of plants and animals
- List of flora and fauna
- Degree of non-destructive harvest
- Percentage of cover by forest type and/or species
- Existence of mechanisms for the conservation of genetic resources

Criterion 4: Conservation and Enhancement of Soil and Water Resources and other Environmental Functions

- Extent of watershed areas under management
- Area under shelter and green belts
- Duration of stream-flow and water yield
- Extent/degree of soil erosion
- Change in level of water table
- Change in sediment load

Criterion 5: Maintenance and Enhancement of Forest Productivity

- The extent of forest area under forest management plans
- Changes in growing stock of wood and NWFPs
- Difference between annual allowable and actual cuts
- Annual NWFP removable/extraction
- Degree of technological inputs

Contribution of forest to GDP through total economic value

Criterion 6: Extent of Forest Resource Utilization

- Per capita wood and non-wood forest produce consumption
- Import and export of wood and non-wood forest products
- Recorded and unrecorded removals of wood and NWFPs

- **Criterion 7: Socio-economic, Cultural and Spiritual Needs**
- The degree of contribution of forest management activities to food security including other livelihood needs
- Level of recreation, cultural, religious and aesthetic needs
- Gender related indices in forestry (GDI in HDR of UNDP)
- Degree of application of traditional knowledge
- Direct and indirect employment in forestry and forest industries
- Contribution of forest to the income of forest-dependent people

Criterion 8: Policy, Legal and Institutional Framework

- Existence of national forest policy and legal framework
- Extent of community, NGO and private sector participation in forestry activities
- Investment in forestry research and development
- Human resource capacity building mechanisms
- Existence of forest resource accounting mechanisms
- Monitoring and evaluation mechanisms
- Existence of mechanisms for information dissemination
- Existence of transfer of technology
- Fiscal and monetary incentives for investing in forestry activity
- Benefit sharing mechanism for stakeholders engaged in forest management activities
- Existence of conflict management mechanisms
- Changes in number of forest offences

[1] Developed by participants from India, Bangladesh, Bhutan, Nepal, Myanmar, Thailand, China, Mongolia and Sri Lanka during the "Workshop on National-Level Criteria and Indicators for Sustainable Management of Dry Forests in Asia" organized by FAO/UNEP/ITTO/HFM, Bhopal, India, 30 November – 3 December 1999.

7. An analysis of sustainable fuelwood and charcoal production systems in The Philippines: A Case Study

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INTRODUCTION

Background

This Philippine Case Study is part of a joint work program between IEA – Bioenergy Task 31 and FAO on the certification of woodfuel and charcoal production systems. The main assumption of this work is hinged upon the reality that there is a growing demand for woodfuels (charcoal and fuelwood) over time both as a source of household and industry end uses. The general concern is that the increased woodfuel use may cause additional pressure to the already diminishing supply of these resources against the current scenario of deforestation and devegetation on a global scale. The necessity of coming up with standards for sustainable management of the origins and sources of fuelwood and charcoal is a top priority in order to ensure renewable production systems vis-à-vis demand.

The problem however is that there are still many aspects influencing the different stages of production of both fuelwood and charcoal that need further documentation, understanding, description and quantification so that a relevant standardization can be achieved. This study then is meant to provide basic information to identify the various chain of custody within the production systems of fuelwood and charcoal with end view of identifying principles, criteria and indicators for the certification of sustainable woodfuel production systems.

Objectives of the study

The Philippine Case Study for both fuelwood and charcoal production systems was conducted with objectives as listed below. The following objectives form the topical sequence of the presentation and formatting of the entire report. First, was to provide basic information regarding the Philippines.

Second, was to examine the fuelwood and charcoal consumption and production chains based on certain facts. This was done by analyzing the socioeconomic, cultural, environmental issues associated with fuelwood and charcoal consumption and production. In addition, a characterization of the consumption and production of fuelwood and charcoal (woodfuels) in the Philippines was documented and analyzed. Objectives one and two however may over-lap in the presentation of this report.

Third, was to review institutional, legal, policy and production systems framework associated with woodfuels in order to trace critical components and links within the production process or the chain of custody that may not conform to sustainable forest management practices. This was the part where key issues that were strategic to certification of the production chain were identified and analyzed.

Fifth, was to sketch Philippine efforts in developing a prescriptive set of objectives towards criteria and indicators for sustainable forest resources management where such objectives both apply on a national scale and on a small management unit scale, for example the forest management units.

Last, was to describe, analyze and suggest criteria and indicators to implement a system of fuelwood and charcoal certification by way of conclusion and recommendations.

Methodology

Like any case study, this is a purely narrative and descriptive report. A number of charts, tables, and graphical presentations are included to provide basic profiles and quantification details to support certain claims. This case study hugely depended upon secondary sources of information obtained from pertinent government offices such as the Department of Energy (DOE), Department of Environment and Natural Resources (DENR), Forest Management Bureau of DENR, Development Academy of the Philippines (DAP), National Statistics Office (NSO), Department of Agriculture (DA), Department of Agrarian Reform (DAR) and National Statistics and Coordination Board (NSCB). The secondary literature were in the form of year end reports, workshop proceedings, contract research reports, media clippings, web posted documents and popular version documents that addressed the concerns of woodfuels in the Philippines.

About 30 percent of the information contained in this report was gathered using primary data collection. Primary collection of data was resorted to in order to verify and confirm what was uncovered from secondary sources. Courtesy calls, telephone calls, and face-to-face interviews were done from several government officials and staff of the above-mentioned institutions. A number of trips were done from Cebu to Manila and other parts of the country to comply with the data requirements of this study.

A number of relevant and valuable documents were uncovered during the course of investigation that may no longer be part of this report due to study scope and limitations. The researcher hopes that these can form part of yet future endeavours so that the initiatives may be continued. To set the study in context, a brief description of the Philippines is in order.

THE PHILIPPINE SETTING

Geography

The Philippines is an archipelago of 7 107 islands located in South East Asia. It has a land area of approximately 30 000 000 hectares. It is bounded on the west by the China Sea and on the east by the Pacific Ocean. Luzon, Visayas and Mindanao are the three principal island groupings classified further administratively into 17 regions and 81 provinces. By and large, the topography of the Philippines is varied consisting of huge masses of mountains, vast plains, extensive rolling hills, wide plateaus and undulating valleys.

Demography

The Philippines is one of the most populous countries in Asia and in the world touted to have three babies born every minute. In the year 2000, the Philippines had a population of 76.5 M with a population growth rate of 2.36 percent, a sex ratio of 101.4, population density of 255 people, and an average household size of 5. The 0–14 age range accounted for 37 percent and the 15–64 years old, 59.2 percent. In 2007, the medium assumption population projection is 88.7 million people. Much of the population still resides in the rural areas but urban migration has increased steadily. Metro Manila with its continued influx of rural migrants has become a very densely populated metropolis, in fact more populous than Metro Paris or Metro Tokyo according to literature. Yet, approximately 15 percent of the country's population resides in Manila.

Human development index

The country's human development index (HDI) ranked 98th out of 174 countries according to the 1998 UNDP Report. This meant an HDI lower than Thailand, Malaysia, China and Singapore. Poverty remains to be country's biggest problem with approximately 40 percent of the population living below poverty line.

The annual average Filipino family income as of 2003 was PHP 147 888 or US$ 616.20 per capita at the exchange rate of 1US$ = PHP 48. In 2006, the country's total labour force was 35.8 M whereby 33.1 M (20.4 M males) were gainfully employed but only 16.7 M were wage and salary workers. The consumer price index (1994=100) was recorded at 129.8 with a headline annual inflation rate of 6.2 percent. Life expectancy is 67.6 years for males and 73.1 years for females. Simple literacy rate is 93.4 percent while functional literacy rate is 84.1 percent as of the year 2003.

Philippine forests

About 30 percent of the total population of the country, particularly the poor, depends upon forest resources for their survival (Coxhead and Jayasuriya, 2003). With a total land area of approximately 300 000 square kilometres, of which 34.85 percent was under forest cover in 1972. Back in the 70s, the Philippines was touted to have the most diversified and economically valuable forest reserve in South-East Asia. It had extensive reserves of broadleaf tropical hardwoods and a considerable reserve of needle-leaf softwoods particularly in Luzon (Salita and Rosell, 1980). Today however, Francisco and de los Angeles (2003) noted that only 3 percent of the original forest covers remain. Figures cited in various literatures vary.

A National Statistics Coordination Board Report by Israel (2002) disclosed that a total forest cover of 5.7 million hectares representing 19 percent of the national land area still remains. Hence, Israel calculates that forest cover is only half of what it was 20 years ago. The numbers differ depending upon classifications, definitions, accuracy and availability of data. There are many issues surrounding 'forest cover' discussions i.e. lack of accurate data. Kummer mentioned that both the Swedish Space Corporation and the Philippine German Forest Inventory reported about 22–23 percent forest cover in the late 1980s. The Forest Management Bureau on the other hand reported about 18 percent in the mid 1990s and JAFTA (unpublished) or the Japan Forest Technical Association also reported 24.7 percent in the mid 1990s. Despite all the differences in estimates and projections, the rate at which forest resources are diminishing remains astounding.

The phenomenon of rapid deforestation is closely linked to the discussion of Philippine forests. In 2002, the World Bank reported a 1.4 percent annual deforestation rate, roughly equivalent to 89 000 hectares for the period 1900–2000. Philippine government sources claim that the average annual deforestation rate is 2 percent. Deforestation in the Philippines is caused by many factors. Land clearance for agricultural purposes brought about by population pressure to move uplands is one major reason. Other than migration patterns and population trends, commercial exploitation of forests resources is also accountable for the loss of valuable forest resources e.g. legal and illegal logging. Weak forest management control schemes and weak enforcement of regulations are also among the causes of deforestation. Lastly, pricing schemes that reflect the true scarcity values of forest resources are likewise inadequate.

The Philippine energy mix

Indigenous energy

The Philippine Department of Energy (DOE) in the year 1996 produced the Philippine Energy Plan (PEP) with a planning horizon of 30 years from 1995–2025. The DOE projection showed that much of the energy mix in the country is dependent upon Indigenous Energy. For instance in 2005, Indigenous Energy consumed stood at 47 percent, while in the year 2010 and 2015, demand is projected to be 42.75 percent and 41.25 percent, respectively. Hence, almost one-half or almost 50 percent of the country's energy need is supplied by indigenous energy resources.

The overall trend in the use of indigenous energy however is that of a decreasing rate during the 30-year planning horizon. This decreasing rate moreover is characterized as "sticky," meaning almost "unnoticed." An example will illustrate this. For the year 2005, the share of indigenous energy was recorded at 47.40 percent and this figure will continue to decrease until the year 2025 where the share will now be reduced to 41.25 percent or a decline by 6 percent spread across 30 years (approximately 0.2 percent). The implication therefore is that the Philippine energy mix will continue to depend upon indigenous energy resources for a long time to come.

Fuelwood in overall energy mix

In the PEP, the category Indigenous Energy in the Energy Mix consists of 13 sub-categories, among them is wood (or wood waste). In the Plan, three sectors have been identified as users of wood and these are: (1) household, (2) industry/commercial, (3) grid electricity [as co-generation with conventional energy].

Among the major inputs in the PEP is wood waste (fuelwood is implicitly part of this category). It is projected that this resource will continue to be a significant contributor to the overall mix accounting for 44 percent of the total new and renewable energy (NRE) demand by 2025. It is in the household sector that the usage of NREs, wood in particular, and was forecasted to be 90 percent in 1996 but will significantly decline to 64 percent by 2025.

Consistent with the overall decreasing trend in the demand for indigenous energy, wood waste has been projected to experience a decline in the next 30 years but it will not be at as sticky" or rigid as that of indigenous energy; in fact it will be more aggressive. The use of biomass resources however will increase. Biomass resource as a general category, which consists of rice residues, coconut residues, municipal waste, animal waste and wood waste, is projected to attain an annual average growth rate of 3.8 percent. Table 1 below shows the origin of fuelwood production among some countries in Asia. In the Philippines, most fuelwood is produced from non-forest lands. This is also true for Bangladesh, Indonesia, Pakistan, Sri Lanka, and Thailand.

Table 1. Fuelwood Production from Forest and Non-Forest Lands in Countries in Asia

Country	Forest (%)[a]	Non-forest (%)[b]	Unknown (%)
Bangladesh	13/75[c]	87/25/82	-
Bhutan	84	16	-
China	Na	26	-
India	51/17[d]	49/83	-
Indonesia	6	65	29
Laos	>90	<10	-
Myanmar	60	40	-
Nepal	82.5/73[d]	17.5/27	-
Country	**Forest (%)[a]**	**Non-forest (%)[b]**	**Unknown (%)**
Pakistan	12.6	84.1	3.3
Philippines	13.7	86.3	-
Sri Lanka	11/12[d]	75/69	14/20
Thailand	-	93	7
Vietnam	80	20	-

Source: Bhattarai 2001 in CIFOR Occasional Paper No. 39
[a] *forest plantations;* [b] *farms, homesteads, community lands, scrub and waste lands, linear plantations;* [c] *estimates from three sources;* [d] *estimates from two sources*

THE DEMAND FOR WOODFUEL

Woodfuel demand estimates

In principle, energy obtained from fuelwood sources may be used for power and non-power applications. In the Philippines, evidence shows that fuelwood and charcoal are used for non-power applications such as residential end uses particularly cooking and industrial uses as well. Over the years, the consumption of fuelwood and charcoal has been notably highest in the household sector, followed by industrial and commercial use. In the PEP, wood waste accounted for 44 percent of the overall NRE estimates. This 44 percent is shared among three sectors: household, industrial/commercial and grid-electricity sectors.

The Household Sector projection trend showed a decline (from 82 percent in 1996 to a mere 49 percent in 2025) in the utilization of NRE (where fuelwood is included). By and large therefore, it is projected that there will be a general decline in the use of fuelwood as fuel source among Filipino households in the years to come. The total amount of fuelwood to be used may experience a diminishing trend, but the fact still remains: fuelwood use will continue to be part of the typical Filipino household.

Woodfuel consumption estimates

Overall, consumption figures at the country-level are a matter of estimation that may be derived from various sources. Table 2 enumerates these various sources and Table 3 is a derivation of best estimates.

Table 2. Various Estimates of Annual per Capita Woodfuel Consumption

Source	Time Period	Per Cap Fuelwood Consumption*	Per Cap Charcoal Consumption*	Remarks
DAP (1992)	1979-1989	Rural: 0.82 cuM (615 kg) Urban: 0.55 cuM (412 kg)	No data	Figures reported are an average of ten different studies ranging in size from 98 to 808 respondents in different regions of the country
Carandang (2001)	1999	Rural: 0.65 cuM (487 kg) Urban: 0.19 cuM (143 kg)	Rural: 0.55 cuM Urban: 0.94 cuM	Results are from surveys conducted of 1,211 households in 13 mainland municipalities of Palawan Province
Bensel and Remedio (1993)	1992	Urban: 303 kg	Urban: 65 kg	Results based on a survey of 603 urban households in Cebu City
Bareng and Acebedo (2000)	1996	Rural: 1.8 cuM (1,305 kg) Urban: 0.93 cuM (677 kg)	Rural: 3.4 kg (20.4 kg wood equiv.) Urban: 7.1 kg (42.6 kg wood equiv.)	Results based on survey of 93 urban and 277 rural households in Ilocos Norte Province
UNDP/ESMAP (1992)	1989	Rural: 543 kg Urban: 394 kg	Rural: 78 kg Urban: 114 kg	Results of the 1989 HECS of 5,082 households
DOE (no date)	1995	Rural: 373 kg Urban: 245 kg	Rural: 33 kg Urban: 25 kg	Results of the 1995 HECS of 6,500 households

Source: Bensel and Remedio, 2002 (Figures are estimates)*

Fuelwood consumption ranges from 20–30 million MT/annum. Charcoal consumption ranges from 2–4 million MT/annum (wood equivalent from 12–24 million MT). Therefore, overall woodfuel consumption in wood equivalent is likely between 32 and 54 million MT/annum. Combined biomass residue consumption ranges from 12–19 million MT/annum. Therefore, overall biomass fuel consumption ranges from 44–73 million MT/annum. Based on the review of the sources available, a single best estimate of consumption in the various categories (reported in the last column in Table 2) was derived. The overall estimated woodfuel consumption in the Philippines is 25 million MT/annum, charcoal consumption at 2.7 million MT/annum (wood equivalent of 16.2 million MT), and biomass residue consumption at 17 million MT/annum. This translates into 41.2 million MT/annum of woodfuel (after converting charcoal to wood equivalent), and 57.2 million MT of overall woodfuel and biomass fuel consumption (Table 3).

Philippine household energy consumption surveys

In the Philippines, three (3) Household Energy Consumption Surveys have been conducted: The first in 1989, the second in 1995 and last one in 2004. A cross-sectional analysis of the three reported years of survey will show three major observations. Firstly, Filipino households do not use only one type of fuel; they use multiple types e.g. kerosene, fuelwood, charcoal, and others. There is therefore a need to distinguish between primary cooking fuels from a secondary cooking fuel.

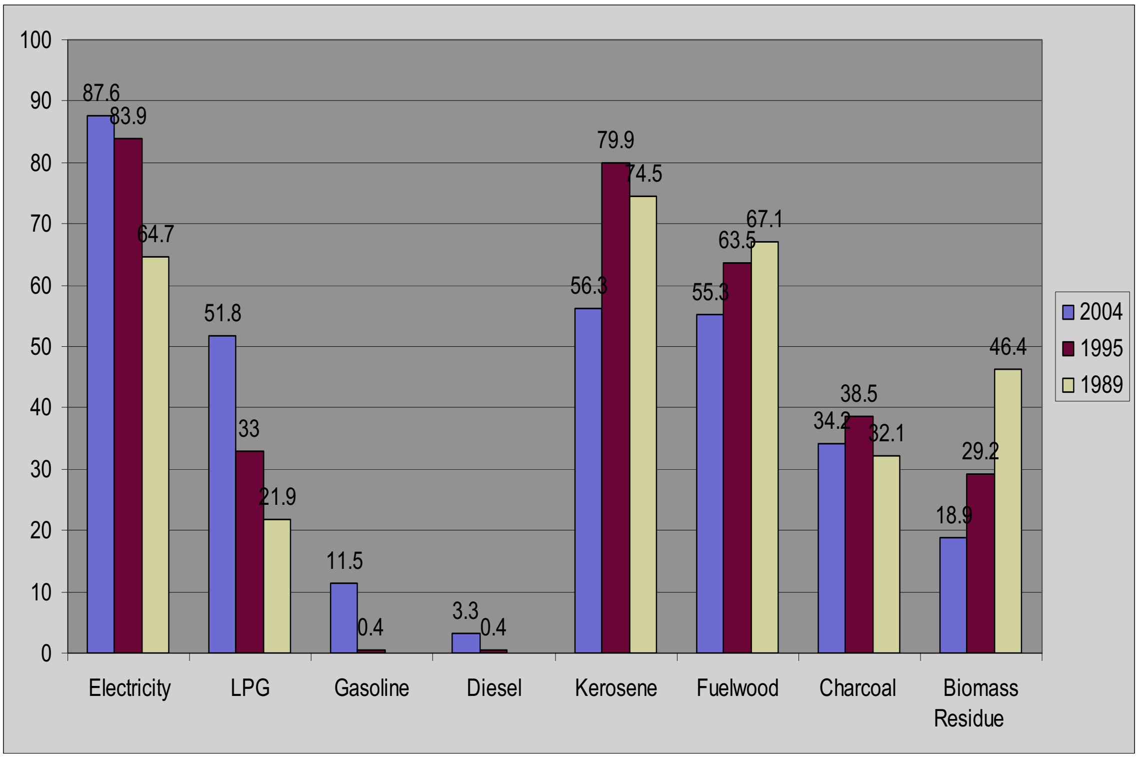
Secondly, there is an increase in the number of households using fuelwood from year 1989 (total of 7 504 households only) up to year 2004 (total of 9 196 households). This is an increase of 18 percent in terms of the number of households using fuelwood within the past 15 years.

Table 3. Best Estimates of Biomass and Woodfuel Consumption in the Philippines

Sector/Fuel	Estimates Range (million metric tons/year)	Best Estimate (million metric tons/year)
Household Fuelwood Consumption	15-20	18
Household Charcoal Consumption	1-2	1.2 (7.2 mil metric tons wood equiv.)
Household Biomass Residues Consumption	2-4	4
Commercial/Industrial Fuelwood Consumption	5-10	7
Commercial/Industrial Charcoal Consumption	1-2	1.5 (9 mil metric tons wood equiv.)
Commercial/Industrial Biomass Residues Consumption	10-15	12
Combined Fuelwood Consumption	20-30	25
Combined Charcoal Consumption	2-4	2.7 (16.2 mil metric tons wood equiv.)
Combined Biomass Residues Consumption	12-19	16
Overall Biomass Fuel Consumption (after converting charcoal to wood equivalent)	44-73	57.2

Source: Bensel and Remedio, 2002

Figure 1. Philippine household energy consumption survey 1989, 1995 and 2004.



Thirdly, there is an overall decline in the use of both fuelwood and charcoal vis-à-vis other types of fuels (such as kerosene, biomass residues), but there is a significant increase in the use of liquefied petroleum gas (LPG) whose demand is steadily rising over the past 15-year period. The demand for LPG was 21 percent in 1989 and it grew to 33 percent in 1995 and now it is at a record high of 51 percent in 2004 (Figure 1).

Biomass fuels are widely used in Philippine households in both rural and urban settings and remains so. The absolute number of fuelwood- and charcoal- using households in the Philippines increased over the 1989–1995 period. In terms of percentage share of households using these fuels, fuelwood declined while charcoal increased. Fuelwood decline can be attributed to increased use of LPG while the increase in charcoal use is due to more widespread use of charcoal for cooking and ironing, although the actual volume of charcoal consumed in the household sector declined during this period.

From 1989–1995 the percentage share of rural households using LPG rose from 9 to 17% which corresponded closely to the decline in number of rural households using fuelwood. The increase in urban household LPG and fuelwood usage is due largely to the 47.4% increase in households classified as "urban", while households considered "rural" declined by 6.1%. This shift in household demographics is due to rural-urban migration and the incorporation of some peri-urban areas into urban boundaries and the reclassification of many municipalities as cities.

Woodfuel/biomass fuel consumption in the Philippines is estimated to be between 30–50 million MT per year. Considering just fuelwood and charcoal, the estimate is between 25–35 million MT per year. The national fuelwood consumption figure is between 20–24 million MT and a charcoal consumption figure of between .86 to 1.65 million MT.

In the period from 1989–1995, household fuelwood consumption declined 3.76 MT and charcoal consumption declined .80 million MT while the population of the Philippines actually grew by 8.5 million people. Preliminary results of the 1989 Household Energy Consumption Survey revealed that in comparison to other Asian countries with moist tropical climates "the survey reported unusually low levels of per capita bio-fuel consumption by households relying on fuelwood as their primary cooking fuel" (UNDP/ESMAP, 1992, Vol. II, p.3).

The HECS reports and other household energy case studies indicate that households often view biomass fuels as easily available and relatively affordable supplemental cooking fuels. A move away from biomass fuels as a primary cooking fuel at one point in time does not preclude the possibility that households could easily revert to their use when faced with price increases or supply difficulties for conventional fuels.

LPG, fuelwood and biomass residues are almost exclusively utilized for household cooking, with very limited use for water heating. Approximately 20% of the charcoal used in the household sector is for ironing and is higher in rural areas where access to electricity is more limited. Most fuelwood, and to a lesser extent charcoal consumption, takes place with the use of crudely crafted, often homemade stones.

In Ilocos Norte, only 41% of fuelwood users and 3% of charcoal users use these fuels solely (Bareng and Acebedo, 2000). This illustrates that many Philippine households retain the ability and generally prefer to make use of multiple cooking fuels simultaneously. This combined with the ease of construction or purchase of biofuel stoves suggests that while biomass fuels may be declining in importance at this point in time, a return to greater use is always a possibility.

Households, in general, found fuelwood readily available, inexpensive and relatively less expensive than conventional fuels. The main attraction to fuelwood use is that it provides a hotter flame and that food cooked with wood tastes better (Bensel and Remedio, 1993). Surveys in Ilocos Norte (Bareng and Acebedo, 2000) and Laguna confirm the importance of factors like affordability/availability of woodfuel, affordability of stoves, availability of free fuelwood supplies, high heat, tradition, taste preferences and specialized cooking needs as important factors in woodfuel use. Majority of households also describe fuelwood as a dirty fuel, while a significant number consider it inconvenient to use. Many households are unable to use fuelwood because of the way their kitchen is set up.

Lower-income households are more likely to use woodfuel and biomass residues. The widespread use of charcoal among upper-income households than lower-income ones may be due to specialized cooking and/or more concentrated charcoal use in urban areas where incomes are higher than in rural areas.

Household fuel choice decisions in the Philippines are highly flexible and highly income and price elastic. (UNDP/ESMAP, 1992). It is important not to view fuel-switching trends over a given period as irreversible or one-directional since sudden changes in fuel prices or availability could easily reverse fuel-switching trends. The most widely cited factor in fuel-switching was convenience. Households switching from fuelwood to kerosene or LPG cited inconvenience, higher cost of fuelwood and lack of space as the primary reasons for switching. Households switching from kerosene to woodfuels did so because of problems with a kerosene stove and fear of fire or explosion.

Woodfuel use among industries

It was found out however that there some industries which also used woodfuels either as primary fuels or combined with others. Tables 2 and 3 show this information.

Table 4. Commercial/Industrial Users of Woodfuels and Biomass Fuels in the Philippines

Industry	Description	Geographic Location	Woodfuel Use Patterns
Bakeries	Use wood-fired "pogon" or brick oven	Nationwide, most rural bakeries apparently still use woodfuels, many urban bakeries have shifted to LPG	Mostly fuelwood, some charcoal
Restaurants/ Eateries	This category would include tens of thousands of "carrenderias" rarely listed as registered businesses	Nationwide, often located in urban areas near to schools, offices, hospitals, and factories. In rural areas these tend to be concentrated in market areas in the municipal centre	Extensive use of both fuelwood and charcoal. Fuelwood often used to cook large batches of food, charcoal to keep food warm for long periods
Barbecue/ Lechon Vendors	Range from sidewalk barbecue vendors to large-scale establishments	Nationwide, more concentrated in urban areas	Mainly charcoal, although some fuelwood might be used to prepare side dishes
Food Processing	Both large-scale and small-scale		

Source: Bensel and Remedio, 2003

The trends in fuel switching

The phenomenon of fuel-switching is multifarious and may not be apparent at first glance. Fuel-switching as a phenomenon needs to be classified as either a switch from a more superior type of fuel to an inferior fuel or from an inferior type of fuel to a more superior type of fuel. Fossil-based fuels are considered as more superior as their technologies are more developed than non-petroleum-based fuels such as charcoal and fuelwood.

The 2004 HECS recorded 7 million households or 43 percent of all Filipino households switched from LPG as their primary cooking fuel to charcoal and fuelwood due to high cost, unavailability and inaccessibility. About the same proportion of households who previously used electricity as their primary cooking fuel switched to LPG, kerosene and fuelwood instead. The main reasons for switching were increased price of their previous primary cooking fuel, change in family income, availability of new cooking fuel, convenience, among others. These are clearly fuel switching from a more superior fuel to an inferior fuel.

The 1995 HECS recorded an increase from 3.3 million households using LPG as primary cooking fuel in 1990, the number rose to 3.8 million in 1995. Even though LPG recorded this increase, fuelwood was still the most popular fuel since 6.1 million households or 48 percent declared that it was their primary cooking fuel. The pace and extent to which household fuel-switching will take place in the future will have an important implication on the levels of fuel demand in the household sector.

Table 5. Woodfuel Consumption by Industry, 1990 (in '000 cubic meters)

Type of Industry	Total		Fuelwood		Fuelwood Substitutes	
	Quantity	Percent	Quantity	Percent	Quantity	Percent
Philippines	14,153.3	100.0	7,822.5	100.0	6,330.8	100.0
Slaughterhouse	429.2	3.0	348.2	4.5	81.0	1.3
Fish Canning	1,960.1	13.9	1,957.7	25.0	2.4	0.0
Vegetable/Animal Oil	122.7	0.9	113.5	1.5	9.3	0.2
Bakery Products	3,925.7	27.7	3,268.3	41.8	657.3	10.4
Sugar Milling/Refining	3,712.4	26.2	100.9	1.3	3,611.5	57.0
Food Manufacturing	987.7	6.0	840.8	10.8	146.9	2.3
Distilleries	71.6	1.5	71.6	0.9	0.0	0.0
Textiles	117.5	0.8	117.5	1.5	0.0	0.0
Leather Tanning	34.9	0.1	20.0	0.3	14.9	0.2
Wood/Cork/Cane Products	92.1	5.1	76.7	1.0	15.4	0.2
Pottery/China/Earthware	917.1	6.7	274.9	3.5	642.2	10.1
Structural Clay Products	685.6	3.3	8.4	0.1	677.2	10.7
Restaurants/Eating Places	1,069.5	4.3	611.4	7.8	458.1	7.2

Source: Bensel and Remedio, 2003

WOODFUEL PRODUCTION SYSTEMS

Socioeconomic and cultural aspects

In developing countries like the Philippines, woodfuel is the major source of cooking and heating fuel for most of the rural communities and for the majority of the urban dwellers. The most important domestic energy resources of this kind include wood, wood waste, charcoal and agricultural residues. Out of total 1 169 peta joules energy consumption in 1993, woodfuel still accounted for 382 peta joules (33%). Additionally, there is no indication that this consumption will be reduced in the future despite a continuing growth in commercial energy consumption (RWEDP, 1998).

The study of Arriola (1998) reported that fuelwood remains the most important fuel in the household sector accounting about half of the energy requirements. The author added that even high income households use this form of energy. About 80% of fuelwood was self-collected and most of these came from privately-owned land with very minimal amount from government land. Her study also gave an account of the misconception that fuelwood contributes to forest denudation.

According to Texon (1998), women in most, if not all countries in Asia and sub-Saharan Africa, take care of daily fuel needs for domestic consumption, work for many hours in smoky kitchen and participate in village woodlots or care home gardens that supply the much needed fuelwood. Women, therefore, play a significant role in the production of fuelwood. They have knowledge on the art of making charcoal and can identify what the properties of materials suitable for fuelwood are. The author added that women even gather woods both for commercial and domestic purposes.

This is so because fuelwood gathering for domestic and commercial purposes requires the utilization of human energy, in which, women contribute the larger part. Fuelwood is an indispensable raw material for women's most important and time-consuming activity, the food preparation. Women are the primary collectors of fuelwood. In various countries, women spend the most number of hours trekking long distances to gather fuelwood Texon (1998). Hence, in the event of deforestation, it would become more difficult for rural women to gather firewood. The elderly people and children also bear the burden of fuelwood collection. The children could perhaps be at school rather than gathering fuelwood and the elderly now deserve to rest rather coping with their energy needs. Texon (1998) recommended that extra efforts should be undertaken to deal with issues confronting women as they play an important role in wood energy system.

The use of wood energy has ill-effects mostly among women who are the most exposed to indoor pollution emitted by fuelwood-based cook stoves. In addition to direct heath effects of cooking with biomass, its growing scarcity and the difficulty in gathering them has indirect effect on the health of the poor. Examples cited by researcher are the tendency of the family to prepare fewer hot meals which may lead to consumption of stale leftover food that maybe contaminated, undercooking and switching to cereal staples that require less cooking but maybe less nutritious. These practices have adverse effects on family nutrition.

The paper of Arriola (1998) identifies the production and marketing systems of woodfuel industry in the Philippines, its socioeconomic and environmental impacts and some policy issues and recommendations for the industry.

Environmental aspects

The extraction activities in woodfuel production may have adverse environmental effects. But the extent in which extraction becomes detrimental or not will depend on the technology employed and the rate of extraction which in turn depends on the demand for fuelwood. It is also important to note that, in contrast to the traditional perception, deforestation is not caused by the heavy reliance of people on wood fuels for energy (Bhattarai, 1998).

The greatest concern about woodfuel as a source of energy is its impact on the environment in the form of carbon dioxide (CO_2) emissions during the combustion process. Rising concentration of greenhouse gases (GHGs) like CO_2 in the atmosphere could lead to climate change or global warming. Based on estimates, CO_2 emissions are greatest when cooking with charcoal and fuelwood (Rebugio *et. al,* 2000). However, the authors cited that while it is true that wood combustion emits CO_2 into the atmosphere, the same amount is recaptured from the atmosphere by the re-growth of wood and by the natural vegetation itself. This approximation is supported by the following evidence. First, it is observed that by far the largest part of woodfuel use takes place on a sustainable basis. This is true for all woodfuels gathered from non-forest lands (e.g. agricultural land, plantations and home gardens) and forest lands. Sustainability implies carbon neutrality. This means that there is no net emission of CO_2 into the atmosphere because the same amount of CO_2 emitted by combusting wood is recaptured from the atmosphere by the standing trees. Second, woodfuels that are the leftovers of non-sustainable logging, slash and burn farming and land conversion and not utilized as fuel would decompose by natural processes and lead to the same amount of carbon emitted in to the atmosphere as when the woody material is combusted.

In addition, the nature of impacts on the environment related to wood energy production and utilization can be categorized into to two: on-site impacts and off-site impacts (Argete, 1998). The on-site impacts refer to the instant local changes of the physical and biological environment following the cutting, lopping, coppicing and transporting of fuelwood. There are negative effects on the hydrologic and nutrient cycles and biodiversity conservation. It can also cause soil erosion and carbon sequestration as well as microclimatic impacts. Off-site impacts are the negative effects on the environment seen on the adjacent and far-flung environment. These may include changes in water yield and flow patterns.

Since both upland and mangrove woodlands are sources of urban fuelwood in many areas, the extraction of wood resources for commercial purposes does give some concerns in regions which are less endowed with forest resources, are easily accessible by boat, and provide wood which is considered excellent for fuel, particularly the commercial fuelwood users (Arriola, 1998). Hence, the extraction activities which consist among other things the choice of species to be cut with or without replacement, the selection of the trees to be cut, the decisions on what of the tree to harvest and the equipment and power, must be done with environmental considerations.

Woodfuel supply and production estimates

The idea to consider when it comes to fuelwood and/or charcoal production is that woodfuel supply is more or less equal to consumption figures since most of the woodfuel consumed in the Philippines is gathered by its users who will unlikely gather more than what they need in the immediate future. All household consumption surveys indicated the same result: households themselves collected or gathered fuelwood either from their own property or other private properties of government land.

Indeed where do woodfuel supplies in the Philippines come from? How much is produced from these sources? What are the current practices in woodfuel production? The succeeding sections will attempt to answer these questions. The totality of economic activities which comprise making fuelwood available to the end user is defined as fuelwood production system regardless of whether or not the sources of the fuelwood is natural resources or plantation backyards (Argete, 1998).

Other than forest resources, woodfuel can possibly be derived from logging residues, Timber Stand Improvements (TSI) removals, processing mill residues, tree plantations, mangrove forests, brushlands, and other alternative sources. Arriola (1998) studied the woodfuel flows of six urban areas[**] in the Philippines. The researcher found out that the sources of wood used to supply the different markets vary greatly from region to region. An important source of fuel in most regions is the village woodlands in agricultural areas.

Virtucio (1970) cited that for every 100 cubic meters of log or timber produced, 80 cubic meters of logging wastes such as tops, branches, stumps, abandoned logs and damaged residuals and butt trimmings, were also produced. TSI operation, on the other hand, can produce on the average, approximately 82 cubic meters per hectare for a ten to twenty-year old second growth forest. Processing of logs including sawmilling, veneering and plywood manufacturing also generates wood wastes. Sawmilling has 36% mill waste while veneering and plywood manufacturing are both estimated to have 47% residue. Arriola (1998) reported that residues from logging and sawmills are essential fuel sources in areas where these activities are present.

The fuelwood from the forest plantations of both the government (established to rehabilitate denuded areas and protect watersheds) and private sectors (established for production purposes) are by-products of an assortment of logs, pulpwood, poles and piles. Mangrove trees as fuelwood have high demand causing also their destruction aside from the conversion to fishponds and prawn farms. Brushlands are common source of fuel wood providing an average volume of 1.95 cubic meters per hectare (DAP, 1992).

Woodfuel production is not fully integrated in farmer's production system, available technologies do not reach the intended end users, potential sources of energy are fully utilized and fuel gatherers may cut anything anywhere (RWEDP, 1998). The following solutions can address the foregoing production and utilization problems: 1) participatory technology development, 2) aggressive information dissemination on woodfuel production and utilization and 3) development of technologies related to the utilization of other potential energy sources.

[**] Areas covered included La Union, Santiago, Isabela, Metro Manila, Cebu City and Tacloban City.

According to Bensel and Remedio Desk Study Report (FAO, 2002), the Philippine Department of Environment and Natural Resources (DENR) estimated 1990 fuelwood supply at 23.18 million cubic meters and fuelwood demand at 38.7 million cubic meters. In a consultant report, John Soussan (1991) on the other hand, estimated that forests could provide over 40 million metric tons of woodfuel every year while non-forest lands could produce close to another 30 million metric tons. Soussan however failed to factor in the issue of accessibility to woodfuels in the forest. He concluded that "the Philippines is a biomass-rich country" yet at the same time he mentioned "pockets" of emerging tress and raises concerns about concentrated harvesting of mangrove forests for commercial users in some urban areas.

One of the major sources of confusion over the issue of woodfuel use and deforestation in the Philippines is the lack of a clear definition of what is a "forest." Confusing the issue further is the lack of a consistent set of land use classifications in the Philippines. The 1989 HECS study concluded that only around 15 percent of the woodfuel used in the Philippines came from forest land with the rest originating from agricultural areas. The 1995 HECS study indicated that 6.6 percent of respondents collected wood from government land, while the DENR Master Plan for Forestry Development estimated 64 percent of households using woodfuel collected wood from forest lands.

The Development Academy of the Philippines (DAP) 1982 Rural Energy Survey and the 1989 HECS reported that around 78 percent of rural household woodfuel users gather supplies from within a kilometre from their homes while over 95 percent gather supplies from within five kilometres. Since most of the rural population lives in agricultural areas, this supports the assertion that most woodfuels originate from non-forest areas or forest edges.

According to Cruz *et al.,* (1991), woodfuels originate from forest lands, although they are primarily a by-product of agricultural expansion. The same study points out those significant quantities of fuelwood and charcoal originating from fruit trees damaged by storms, from trees and shrubs grown on agricultural lands and from brushlands that may be under government or private ownership.

Carandang (2001) found that 71 percent of rural fuelwood users obtained supplies from their own farms while 27 percent obtained them from public forest. Wiersum (1982) suggests that primary forest contributed only a limited amount to overall woodfuel production and found large plantations established in response to concentrated commercial demand for fuelwood and charcoal in nearby industries or cities. Wiersum therefore concluded that most woodfuels originate from agricultural lands and brushlands.

Bensel and Remedio (1993, 2002) indicated that the bulk of the commercial fuelwood and charcoal sold in Cebu City and surrounding urban areas originated from tree and shrub fallows. Their studies revealed that most of these tree and shrub fallows were established deliberately by upland farmers and landowners on what had been a cogon grass dominated landscape. In addition to these lands, 15–25 percent of Cebu's commercial woodfuels originate from fruit trees either knocked down by storms or uprooted as part of an agricultural cycle. Woodfuels in Cebu are also sourced from brushlands stocked with indigenous tree and shrub species, and logging residues from private tree plantations.

Bareng and Acebedo (2000) reported that in Ilocos Norte, woodfuels come from tree fallows, woodlots, private tree plantations, agroforestry systems and isolated/scattered trees found throughout the landscape. Open canopy secondary growth forests in Ilocos Norte remain an important source of woodfuels especially for commercial users.

Current land use practices in the Philippines are capable of producing over 85 million MT of wood for fuel annually, excluding wood from primary forests which are inaccessible. It also does not include coconut and other crop residues that are available for use as fuel.

The 1998 Swedish Space Corporation report categorized over 10 million hectares of land as cultivated mixed with brushland and grassland with an estimated productivity of 8t/ha/year. Other areas characterized as brushland or extensive mixed land uses have an estimated productivity of 5t/ha/yr. Grasslands have an estimated productivity of 1t/ha/yr while tree plantations may yield 2t/ha/yr. Secondary forests, agricultural land and coconut plantations have an estimated yield of 6, 2 and 2t/ha/yr., respectively.

Estimating woodfuel supply accounts for the enormous woodfuel potential of "in-between lands" that make up close to 30 percent of Philippine land area. These lands have tended to escape the interest of the forestry community because they could not be considered forest. Likewise, the agricultural community cannot appreciate these lands because they are too steep and unsuitable for commercial agricultural purposes. These "wastelands" play an essential part in meeting the energy and other subsistence needs of rural communities and have come about as intentional establishments to suppress cogon or as natural re-growth in the wake of agricultural abandonment.

In his 1991 consultant report, Soussan indicated that the key fuelwood resource in rural areas is the "village woodlands," although very little is actually known about them. Other studies, including those mentioned above, make reference to more or less the same kind of resource, referring to them as tree or shrub fallows, family woodlots, brushland or shrubland, reproductive brush, secondary forest, coppice forest, shrub forests and so on.

Despite the range of terminologies used to describe them, what can be said with some certainty about these areas is as follows. First, they are generally on private land, in predominantly agricultural areas, where the bulk of the rural population resides. Second, the degree to which they can be described as open-access depends in large part on the presence or absence of commercial woodfuel markets in the vicinity. In places where commercial demand exists, which is believed to be the norm, access to the resource is monitored and restricted, although this does not necessarily mean that local woodfuel users are completely denied access and face woodfuel shortages.

Third, in some cases they represent natural re-growth of pioneer forest species in the wake of agricultural abandonment or commercial logging. Apparently just as common is that these areas were intentionally established on marginal grasslands using fast-growing species like *Leucaena* and *Gliricidia* whose chief advantages are their ability to compete with cogon, fix nitrogen and be coppiced on a regular rotation. Fourth, their area, while difficult to determine, is probably in the range of from 6–10 million hectares (20–30 percent of the country's total land area).

Lastly, they are without a doubt the major source of woodfuel for rural and urban households, and for commercial/industrial establishments in the Philippines. The fact that so little is known about the extent of this resource, its management and productivity and how it has changed over time is in large part responsible for so many of the dire warnings on woodfuel supply in the Philippines that have never come to pass. If agricultural woodlands are managed properly they alone can produce enough wood to meet residential and commercial/industrial woodfuel requirements in the Philippines.

It is assumed that woodfuel supply is more or less equal to woodfuel consumption. This is so for various reasons. For instance, most of the woodfuel consumed in the Philippines is gathered by its users and it is unlikely that users will gather much more than they would need in the immediate future. Even traded woodfuels, being a commodity subject to decomposition (in the case of fuelwood) and damage from the elements, are unlikely to be produced in quantities significantly greater than what consumers demand.

Therefore, it is suggested that woodfuel "supply" in the Philippines is roughly equivalent to the consumption figures reported earlier. However, a more interesting set of questions relates to the issue of whether this supply of woodfuels is being produced in a manner that does not compromise future supply potential. In other words, in meeting current woodfuel demands are woodfuel users and traders undermining the *potential* for a sustained production of these fuels into the future. These questions of *how* woodfuels are produced in the Philippines, *where* they originate from, and what the *potential supply* of woodfuel is that can be produced on a sustained basis, are the more relevant questions to investigate.

It is still widely assumed in the Philippines that woodfuel extraction contributes to deforestation and environmental degradation. In addition, because of the rapid loss of forests in the Philippines in the last 30–40 years it is also generally accepted that the country is facing or already experiencing woodfuel shortages. These perceptions persist despite a growing body of evidence indicating that most woodfuel production in the Philippines comes from agricultural areas, and that tree planting and management for woodfuel purposes is widespread in many regions of the country.

In order to explore these issues a presentation of a series of woodfuel production/supply estimates for the Philippines and the assumptions behind them are presented in Table 6. Next is to examine evidence on patterns of woodfuel production in the country, paying particular attention to the ways in which "trees outside the forest" contribute to the bulk of woodfuel production. This is followed by an attempt to estimate woodfuel production potential in the country given what we know about the geographical distribution and productivity of different woodfuel producing land use systems.

Table 6 presents information from eight sources on woodfuel and biomass residue production/supply potential in the Philippines. Looking first at woodfuels, the range of estimates is from 17 million MT to nearly 110 million MT. The most widely cited estimates are the highly divergent figures developed by the DENR as part of the Master Plan for Forest Development (MPFD) and those put forth by the UNDP/ESMAP 1989 HECS project, and so we focus on these.

Table 6. Estimates of woodfuel production/supply potential in the Philippines

Source	Year of estimate	Woodfuel production/supply potential	Other biomass fuel production/supply potential	Remarks
DAP (1992)	1990	MPFD estimates Forests: 4.23 million MT Non-Forests: 13.16 million MT Total: 17.39 million MT		Estimates are for woody biomass fuels only and take into consideration issues of accessibility of fuelwood users. Estimates refer to annual sustainable yield.
UNDP/ ESMAP (1992)	1988	Forests: 40.36 million MT Non-Forests: 29.68 million MT Total: 70.04 million MT	Coconut Residues: 36.61 million MT	Estimates apparently do not consider issues of accessibility of fuelwood users to potential supplies in forest areas.
DOE (1999)	1999	Wood/ Woodwastes: 84.721 MMBFOE (33.09 million MT wood equivalent)	Rice Residues: 7.666 MMBFOE (3.32 million MT) Coconut Residues: 23.245 MMBFOE (10.02 million MT) Bagasse: 18.143 MMBFOE (7.09 million MT) Total: 49.054 MMBFOE (20.43 million MT)	All figures reported in MMBFOE (million barrels fuel oil equivalent). MMBFOE converted to weight assuming 6.25 GJ/BFOE and using the following conversion factors: wood/woodwastes 16 GJ/MT; rice residues 14.4 GJ/MT; coconut residues 14.5 GJ/MT; bagasse 16 GJ/MT.
Nera (1998)	2000	Total: 27.78 million cuM (20 million MT)		Estimate derived by summing sustainable annual supply estimates from different land-uses (e.g. forest, plantations, brushlands) as well as waste wood.
RWEDP FD#50 (1997)	1994	Forests: 12.96 million MT Agricultural Areas: 30.82 million MT Waste Woodfuels from Deforestation: 45.49 million MT Total: 89.27 million MT		Forest and agricultural area estimates described as "sustainable woodfuel" while waste woodfuels from deforestation is based on an assumed annual rate of deforestation and corresponding wood by-products available from that process.
Koopmans (1998)	1997		Rice Residues: 22.81 million MT Maize Residues: 10.71 million MT Sugar Residues: 15.93 million MT Coconut Residues: 35.87 million MT Total: 85.325 million MT	Estimates divided into field-based residues, process-based residues and agro-based wood residues.
Quejas (1996)	1990	Total: 109.68 million cuM (79 million MT)		Cites Misajon et al. (1989) as original source. Not clear if estimate refers to just woodfuels or also includes other forms of biomass fuels.
PRESSEA (2002)	1996	Total: 489.77 PJ (30.62 million MT)	Rice Residues: 44.29 PJ (3.08 million MT) Coconut Residues: 112.73 PJ (7.77 million MT) Bagasse: 67.04 PJ (4.19 million MT) Total: 224.06 PJ (15.04 million MT)	Estimates derived from data provided by Philippine DOE – Non Conventional Energy Division. Converted from PJ to weight using conversion figures described above for DOE.

Source: Bensel and Remedio, 2003

The DENR estimated 1990 "fuelwood supply" at 23.18 million cubic meters (around 17 million MT), and firewood demand at 38.7 million cubic meters (28.25 million MT), indicating a fuelwood deficit of 15.52 million cubic meters (11.33 million MT).

In addition, the DENR projected fuelwood deficits of from 16.6 to 18.7 million cubic meters for 2000, and from 14.9 to 20 million cubic meters for 2015 under different scenarios. It is not made clear in the Master Plan exactly how the 1990 deficit of over 11 million MT was actually met, and just how demand could have exceeded supply. Presumably, these figures are meant to be indicative of what the DENR determined to be fuelwood supplies that were *accessible* to users and those that could be produced on a *sustained yield* basis.

Therefore, the "woodfuel gap" had to be met through unsustainable and often illegal cutting of trees in forested areas. In order to meet the projected shortfall, the DENR MPFD calls for a combination of approaches, namely the substitution of alternative fuels for woodfuel, establishment of woodfuel plantations on 300 000 hectares of land, and distribution of improved cookstoves to increase the efficiency of use. Ever since its publication in 1990, the DENR MPFD woodfuel statistics have been widely cited and used in the literature on woodfuel in the Philippines, right up to the present. The enormous supply-demand gap portrayed in the MPFD is in large part responsible for the persistence of the belief that the Philippines face serious woodfuel problems.

By way of contrast, the 1992 UNDP/ESMAP report summarizing results of the 1989 HECS project paints a much more optimistic picture. The UNDP/ESMAP woodfuel production/supply potential figures originated in a consultant report prepared by John Soussan (1991). In that report, Soussan combined recently released satellite data on forest/non-forest land uses in the Philippines with potential woodfuel yield data for each land use in order to develop his totals. For example, dipterocarp forests were assumed to yield an annual increment of between 5 and 7 tons/hectare/year (t/ha/yr), while a figure of 2t/ha/yr was used for mixed extensive farmland and 1 t/ha/yr for intensive farmland. Soussan estimates that forests could provide over 40 million MT of woodfuel every year on a sustained yield basis while non-forest lands could produce close to another 30 million MT. One apparent difference between Soussan's estimates and those in the MPFD is that Soussan did not factor in the issue of accessibility to woodfuels in the forest. But even still, Soussan's estimates of almost 30 million MT/year available from non-forest lands is nearly three times as great as the MPFD total. Combining this with an estimate of over 36 million MT in coconut residues available annually yields over 60 million MT of biomass fuels available from non-forest lands every year – at least one order of magnitude greater than household woodfuel demand. As a result, Soussan concludes "the Philippines is a biomass-rich country" (p.7), although he warns of "pockets" of emerging stress and raises concerns about concentrated harvesting of mangrove forests for commercial users in some urban areas.

The other estimates presented in Table 6 vary depending on how they were developed. The DOE estimate of 33 million MT of wood equivalent is provided without much explanation, and figures reported in PRESSEA are generally derived from information provided by DOE. The estimate by Nera follows very closely the approach used in the DENR MPFD, while the figures presented in RWEDP (1997) were calculated using a similar approach as Soussan. Estimates for other biomass fuel production/supply potential also vary quite a bit, although they all generally point to substantial quantities of biomass residues available to household and commercial/industrial users. The most abundant of these is coconut residues, with a detailed accounting by Koopmans (1998) suggesting a figure of 36 million MT of coconut residues available yearly. The fact that such large quantities of biomass residues are available, but that actual consumption remains relatively low, tends to undermine any claim of widespread woodfuel shortages in the Philippines, although high rates of consumption in some areas might reflect more localized shortages.

It is clear from these discussions that there is a dearth of knowledge on the productivity and potential of woodfuel producing land use systems in the Philippines. One of the major sources of confusion over the issue of woodfuel use and deforestation in the Philippines is the lack of a clear definition of what is a "forest." Officially, over 50 percent of the Philippine land area of 30 million hectares is classified as "forest land," despite the fact that recent forest surveys put actual forest cover at between 20–25 percent. This is a result of lands with a slope over 18 degrees being classified by the government as forest land regardless of its actual land use.

Further confusing the issue is the lack of a consistent set of land use classifications in the Philippines. A World Bank-funded effort to map natural conditions in the Philippines using satellite imagery classified 24 percent of the country as having forest cover and 33 percent as an "intensive land use," mainly arable crops and plantations. However, as much as 40 percent of the country was characterized as having an "extensive land use," with most of this described as "cultivation mixed with brushland and grassland."

Many of these extensive land uses include significant amounts of trees and shrubs, and local people in these areas often refer to them as "forest" or "woodland." In the end, therefore, it is extremely difficult to speak with any certainty about the actual extent of forest cover in the Philippines and the role of forests in the provision of woodfuel supplies.

With that qualification in mind, it is interesting to examine the land use data used in the development of the woodfuel supply potential figures discussed in the last section. Table 7 presents land use data from two sources. The SSC column refers to the World Bank-funded mapping project undertaken by the Swedish Space Corporation (1988) using SPOT satellite imagery. The DENR-MPFD column refers to data presented in the Forest Master Plan which was developed through a combined analysis of the SSC results and those of the Philippine-German Forest Resource Inventory. Both efforts put forest cover at around 22–24 percent of total land area. However, since they use different categories it is difficult to determine how much actual agreement exists between them. Both studies also put extensive land use at between 35–40 percent of total area, although here again the use of slightly different categories makes comparison difficult. Only the SSC report breaks down intensive land use, but here too the studies are in fairly close agreement as to the extent of coverage of this land use.

How do these land use categorizations fit with what is known about woodfuel production practices? Both the 1989 and the 1995 HECS studies asked respondents about the source of their woodfuels. The 1989 study concluded that only around 15% of the woodfuel used in the Philippines came from "forest land" with the rest originating from agricultural areas. The 1995 HECS worded the questions in a slightly different manner; asking respondents to indicate whether wood came from their own land, other private land, government land, or others. Only 6.6 percent of the respondents indicated that they collected wood from government land, the category most closely associated with forest.

Table 7. Land use classifications in the Philippines

Land Use	SSC (1988)		DENR-MPFD (1990)	
	Area ('000 ha)	%	Area ('000 ha)	%
Forest				
Dipterocarp, closed	2,434.5	8.1		
Dipterocarp, open	4,194.0	14.0		
Pine	81.2	0.3	238.3	0.8
Mossy	245.5	0.8		
Mangrove	149.4	0.5	119.1	0.4
Old growth dipterocarp			984.1	3.3
Second-growth			3,455.8	11.5
Mossy/marginal			1,412.7	4.7
Plantations			482.7	1.6
Total Forest	*7,104.6*	*23.7*	*6,692.7*	*22.3*
Extensive Land Use				
Cultivated/open forest	30.4	0.1		
Grassland	1,812.9	6.1		
Cultivated w/brush & grass	10,114.3	33.8		
Brushland			2,459.1	8.2
Large-scale grassland			1,542.9	5.1
Other extensive			6,594.8	22.0
Total Extensive	*11,957.6*	*40.0*	*10,596.8*	*35.3*
Intensive Land Use				
Coconut plantations	1,132.6	3.8	11,787.7	39.3
Other plantations	90.8	0.3		
Arable crops (sugar, rice)	4,392.3	14.7		
Crops mixed w/coconut	3,747.8	12.5		
Crops/other plantations	365.2	1.2		
Fishponds	205.3	0.7		
Total Intensive	*9,934.0*	*33.2*	*11,787.7*	*39.3*

Source: Bensel and Remedio, 2002

However, the DENR MPFD estimates that 64 percent of woodfuel-using households in the Philippines collect wood from forest lands, although no explanation is provided as to how this figure was reached. Below are observations worth considering:

- DAP (1992) reports that a 1982 rural energy survey and the 1989 HECS indicate that between 73–83% of rural household, woodfuel users gather supplies from within one kilometre of their home, while over 95% gather supplies from within five kilometres. Since most of the rural population lives in agricultural areas (either extensive or intensive), this tends to support the assertion that most woodfuels originate from non-forest areas or forest edges.

- Cruz *et al.* (1991) provide a detailed discussion of how commercial charcoal making takes place in recently logged-over areas of Laguna Province. In this case, charcoal making is part of the process of transforming secondary forest to "*kaingin*" or farm plot. Charcoal is produced from smaller diameter trees, bushes and shrubs and income from its sale helps support the family until the farm is better established. Subsequent maintenance of the *kaingin* also yields charcoal for market sale, although usually in smaller quantities than the initial clearing. In this case, woodfuels are originating from forest lands, although they are primarily a by-product of agricultural expansion.
- The same study by Cruz *et al.* also points out that significant quantities of fuelwood and charcoal originate from fruit trees damaged by storms, from trees and shrubs grown on agricultural lands, and from "brushlands" that may be under either government or private ownership. In some cases this production involves a regular coppice rotation using species like *Gliricidia sepium* or *Leucaena leucocephala*. In other cases, charcoal is produced from the stumps and roots of coppiced *Gliricidia* and *Leucaena* that have been uprooted to make way for citrus plantations. Overall, the Cruz *et al.* study indicates that in recent times significant quantities of woodfuels were made available from forest areas as a by-product of their conversion to agriculture. Elsewhere, woodfuel production on a more sustained basis from fruit trees and from planted, fast-growing species like *Gliricidia* and *Leucaena* was also important. However, the latter production system was being threatened by conversion to citrus plantations.
- In a study of woodfuel production and use on Palawan (one of the most forested provinces in the country), Carandang (2001) found that 71% of rural fuelwood users obtained supplies from their "own farms" while 27% obtained them from "public forest."
- The 1990 FCS of commercial/industrial establishments (FMB/NSO, 1990) asked respondents about the source of their woodfuel supplies and the species they used. Ninety-nine percent of businesses purchasing woodfuels were able to obtain adequate supplies from within their province, while 52% were able to obtain supplies from within four kilometres. This would tend to suggest that even in areas where woodfuel shortages are thought to exist (e.g. Ilocos, Cebu), businesses are still able to obtain supplies locally. In terms of species, 66% of the businesses reported using *Gliricidia*, *Leucaena* and other species common in agricultural and brushland areas, while 49% reported using wood from fruit trees. In contrast, only 23% reported using species like *Shorea negroensis* (Red Lauan) and *Shorea polysperma* (Tanguile), species common to forest areas.
- In a 1982 consultant study of woodfuel issues in the Philippines, Wiersum conducted rapid appraisals of production practices in at least eight provinces. In Laguna, Ilocos, Cebu and Panay, Wiersum found large areas of private land covered by what he called "indigenous" fuelwood plantations, consisting mainly of *Leucaena glauca* (native ipil-ipil), *Leucaena leucocephala* (giant ipil-ipil) and *Gliricidia*. These plantations were often established in response to concentrated commercial demand for fuelwood and charcoal in nearby industries (e.g. tobacco curing in Ilocos)

or cities. Wiersum also suggests that primary forests contribute only a limited amount to overall woodfuel production, mostly in the form of logging residues. However, an analysis of commonly used species suggests that secondary forests – which tend to be closer to rural populations and which tend to contain trees of a size that can be easily harvested – play a more important part in meeting woodfuel demand. Overall, Wiersum concludes that most woodfuels originate from agricultural lands and brushlands.

- Wiersum's mention of private fuelwood plantations in a number of provinces may not have reflected a recent phenomenon. In a series of annual reports prepared by the Director of Forestry of the Philippine Islands from 1916-1938 (DANR, various years) regular mention is made of the practice of using *Leucaena glauca* to reforest and rehabilitate degraded grasslands. *Leucaena* was favoured for its ability to "kill out cogon grass within two years," for its ease of establishment through broadcasting of seeds, because it produced firewood and fodder, because it fixed nitrogen, and because it coppiced readily, allowing rapid regeneration after repeated harvests. The 1916 report mentions "several municipalities" using it to reforest cogon lands and private individuals which have "planted ipil-ipil on their cogon lands and are cutting on a one or two year rotation for firewood" (p. 33). The 1917 report describes a "regular rotation system being followed by farmers in Laguna, Panay and Cebu" (p. 18) and the start of widespread planting in La Union, Ilocos Norte, Ilocos Sur and Zambales. Interestingly, the 1921 report describes a timber and firewood "famine" in the Ilocos region and calls for immediate reforestation activity. Overall, the Director of Forestry reports help to illustrate a couple of important points. First, large areas of tree/shrub forests in places like Cebu, Panay and Ilocos did not come about by accident. Instead, they are the result of deliberate planting and continuous management by private landowners for as long as 80 years. Second, the reports suggest that in some places the woodfuel situation may have actually gone from worse to better, a prospect not usually discussed in the literature on woodfuels in the Philippines or elsewhere.
- Two extensive studies of the woodfuel situation on Cebu – the most deforested province in the country – suggests that the *Leucaena* reforestation efforts described in 1916 eventually spread to cover a significant portion of the central uplands of the island within 20–30 kilometres of Cebu City. The 1993 report of Bensel and Remedio indicated that the bulk of the commercial fuelwood and charcoal sold in Cebu City and surrounding urban areas originated from "tree and shrub fallows" (mostly *Leucaena* and *Gliricidia*) managed on a 2–5 year coppice rotation cycle. A 2002 follow up study examined more closely the origin of these tree/shrub systems and revealed that most were established deliberately by upland farmers and landowners on what had been largely a cogon grass dominated landscape. Older respondents indicated that that this kind of planting occurred over a large area of the central uplands (covering perhaps 10 000 hectares) from the 1920s through the 1960s, and that the primary impetus for planting was to

produce wood for urban woodfuel markets. Cebu's shrub forests or "coppice lands" are usually established on steeply sloping land less suitable to farming, although a sequential intercropping of tubers, corn or other crops around coppiced stumps is also common. Many of these coppice lands have been harvested on a continuous basis every 2–5 years for over 70 years. In addition to coppice lands, as much as 15–25% of Cebu's commercial woodfuels originate from fruit trees either knocked down by storms or uprooted as part of an agricultural cycle. Likewise, Cebu's extensive coconut area also provides abundant supplies of fronds, husks and shells for rural subsistence use and urban market sale.

- Two other important sources of woodfuels on Cebu are brushlands stocked with indigenous tree and shrub species and logging residues from thousands of private tree plantations (stocked with species like Gmelina and Mahogany) established throughout the island in the last twenty years. The brushlands represent more natural re-growth of trees and shrubs in the wake of *kaingin* abandonment, and are generally found further to the south and north of the island. Private tree plantations are mainly intended to produce wood for lumber mills, pulp mills and woodcraft industries, but the "lops and tops" from harvests and the off-cuts from sawmills were found in 2002 to be making up a much larger share of total woodfuel use than in 1993. Ironically, the 2002 study found some areas of coppice lands and brushlands that were being harvested and then permanently uprooted in order to make way for either tree plantations or mango orchards. Such a land use change will generally result in reduced woodfuel supplies even if tree plantations and fruit tree orchards will continue to generate some woodfuel production. Overall, both the 1993 and 2002 Cebu woodfuel studies revealed just how significant woodfuel production from non-forest lands can be. Despite being nearly totally deforested for at least the past 100 years, its status as one of the most densely settled islands in the country, and large-scale consumption of woodfuels by rural and urban households and businesses, Cebu has remained self-sufficient in woodfuels. Repeated predictions of woodfuel shortages on the island have never materialized, illustrating well the problem with overlooking non-forest lands as a source of woodfuels in the Philippines.
- A recent study of the woodfuel situation in Ilocos Norte likewise found that much of the subsistence and commercial woodfuel demand was being met from agricultural lands. Bareng and Acebedo (2000) report woodfuels coming from tree fallows of *Leucaena* and *Gliricidia*, woodlots harvested on a 3–4 year coppice rotation, private tree plantations, agroforestry systems, and isolated/scattered trees found throughout the agricultural landscape. Unlike Cebu, however, Ilocos Norte still has over 40 000 hectares of forest – mostly open canopy secondary growth – and these remain an important source of woodfuels, especially for commercial users demanding larger diameter pieces of fuelwood.

Table 8. Woodfuel Supply Estimates from Different Land Uses in the Philippines

Land Use	Annual Yield ('000 metric tons)	
	Soussan (1991)	DENR (1990)*
Forest	405	167
Pine	492	
Mossy	39,508	1,956
Dipterocarp	1,490	175
Mangroves		832
Plantation		153
Marginal		
Total Forest	*41,895*	*3,283*
Non-Forest	20,228	
Mixed Extensive Farmland	4,392	5,650
Intensive farmland	36,607	
Coconuts (coconut residues)	1,368	
Other Plantations	907	37
Grassland		3,507
Brushland		3,489
Other Extensive		124
Urban, Others		832
Wastewood		
Total Non-Forest	*63,503*	*13,636*
Overall Total	**105,398**	**16,919**

* DENR figures originally presented in cubic meters, converted to metric tons assuming 1 cubic meter of wood = 730 kilograms.

- A community agroforestry project in Cavite Province asked key informants to identify desirable characteristics of tree and shrub species to be propagated in the project nursery for distribution to participating farmers (Pastores and Buenaventura, 2002). The respondents wanted trees and shrubs that could be planted as pioneer species on infertile open grassland that were hardy, had good coppicing ability, multiple uses and were readily available. When asked to rank ten different species on these criteria they rated *Gliricidia sepium* first and *Leucaena* second. The popularity and widespread distribution of these species throughout the country is an indication of their suitability as a "woodfuel crop" and explains the common practice in many areas of setting aside at least some land for their propagation. In Cebu and Negros Oriental *Leucaena* is often intercropped with coconut (Cadelina, 1988; Bensel and Remedio, 1993), enhancing the biomass fuel productivity of these lands. In many regions *Gliricidia* is cultivated as a living fence (Wiersum, 1982), while both *Gliricidia* and *Leucaena* are often intercropped with root crops, corn and vegetables in between coppicings (Bareng and Acebedo, 2000; Bensel and Remedio, 1993).
- In areas with a significant logging and wood processing industry, logging and sawmill residues constitute a significant share of local woodfuel production. For example, in the area around Cagayan de Oro City in Misamis Oriental, Mindanao, logging wastes in the year 1988 were estimated at 590 000 MT. Sawmill wastes from the area's 28 sawmills were estimated at 430 000 MT (Soussan, 1991). Local woodfuel consumption in this

region is significantly less than this, and most of this consumption takes the form of logging and sawmill residues. Likewise, and FAO-RWEDP report (Field Document #50, 1997) estimated that on an annual basis waste wood from deforestation in the Philippines could yield over 45 million MT of woodfuel. However, since most deforestation occurs a significant distance away from population centres, only a tiny fraction of this wood is actually used as fuel. These findings tend to undermine any claim that woodfuel use is a leading cause of deforestation in the Philippines, and they make clear the more significant role that trees outside forests – in the agricultural landscape – play in meeting woodfuel requirements.

Two of the most widely cited supply estimates in the Philippines is presented in Table 8. Essentially, both sets of estimates originated from the land use statistics presented in Table 7. Soussan relied on the data presented in the SSC columns while the DENR estimates were derived from the data in the DENR-MPFD columns.

Here we seek to revise these woodfuel potential estimates based on a more careful consideration of evidence about the productivity of woodfuel producing land uses. In particular, attention needs to be focused on potential supplies from non-forest lands since these accounts for the bulk of the country's woodfuel production.

While there is relatively limited information on the woody biomass potential of agricultural and other non-forest lands in the tropics, what does exist suggests that the productivity factors used by both Soussan and the DENR are probably too low to reflect actual conditions in the Philippines based on the following considerations:

- In a recent article in *Wood Energy News*, Keith Openshaw suggests that woodlands in tropical regions receiving an annual rainfall of 2 000 mm (as is the case in much of the Philippines) produce approximately 14 dry tons of biomass per hectare annually, with anywhere from 40–70% of this biomass in the form of wood (6–10 tons of wood/hectare). Openshaw compares this with figures often used in forest service studies in the region of from 0.1 to 2 t/ha/yr.
- A comprehensive 1980 report on firewood crops produced by the U.S. National Academy of Sciences presented annual yield data for dozens of trees and shrubs. Of those trees and shrubs commonly found in the Philippines the following yield data were reported. *Casuarina equisetifola*, 10–20 t/ha/yr; *Leucaena leucocephala*, 22–30 t/ha/yr; *Sesbania grandiflora*, 15–20 t/ha/yr.
- In a study on woodfuel productivity of agroforestry systems in Asia, Michael Jensen reviewed dozens of studies in order to develop reasonable estimates of productivity from different tree/crop/livestock combinations. For "agri-silviculture" systems, most common in the Philippines, Jensen estimates an average wood productivity of 14.1 ± 9.9 t/ha/yr, with some systems producing as low as 3.5 t/ha/yr or as high as 42.3 t/ha/yr. It should be noted here that these wood productivity figures are for agroforestry systems that simultaneously produce food crops, fruit, fodder and other products. Large areas of extensive land use in the Philippines fit under this category.
- In his 1982 study, Wiersum estimated the average productivity of *Gliricidia* and *Leucaena* woodlots in Ilocos and Cebu at 17–29 t/ha/yr and 20t/ha/yr, respectively. In terms of home gardens and agricultural fields with scattered trees, Wiersum estimated potential yields of 5–7 t/ha/yr and 2–6 t/ha/yr, respectively. The *Gliricidia* and *Leucaena* woodlots are more reflective of what is often labelled an extensive land use in the Philippines, while home gardens and agricultural fields would fall under the intensive classification.

Table 9. Revised woodfuel potential estimates for the Philippines

Land Use	Estimated Area ('000 ha)	Productivity (t/ha/yr)	Accessibility	Total Annual Yield ('000 MT)
Brushland	4,000	8	100%	32,000
Other Extensive	4,000	5	100%	20,000
Grassland	2,000	1	100%	2,000
Tree Plantations	1,000	2	80%	1,600
Secondary Forest	4,500	6	50%	13,500
Agriculture	4,000	2	100%	8,000
Coconut, Crop/Coconut*	4,000	2	100%	8,000
Total	**23,500**			**85,100**

* Woody biomass from intercropped trees and shrubs

The above discussion makes clear that the woodfuel productivity figures used by Soussan and the DENR are probably too low for conditions in the Philippines. Soussan acknowledges this by stating "all of the estimates made where no firm measurements are available are conservative" (p. 16). Woodfuel productivity figures used by the DENR are probably on the order of ten times too low given what is known about these land use systems. Table 9 presents a revised set of estimates for woodfuel productivity/supply potential in the Philippines. Land use data from SSC (1988), DENR (1990) and more recent results from a forest survey conducted by the Japan Forestry Technical Association (JAFTA) to develop approximate estimates of the area of different woodfuel producing land use systems, were considered. An overall current land use practice in the Philippines is capable of producing over 85 million metric tons of wood for fuel annually. This figure excludes wood from primary forests since much of this is inaccessible, and it also does not include the significant quantities of coconut and other crop residues also available for use as fuel. Despite that, the figure of 85 million MT is greater than any estimate of woodfuel demand in the country, suggesting a favourable supply-demand picture.

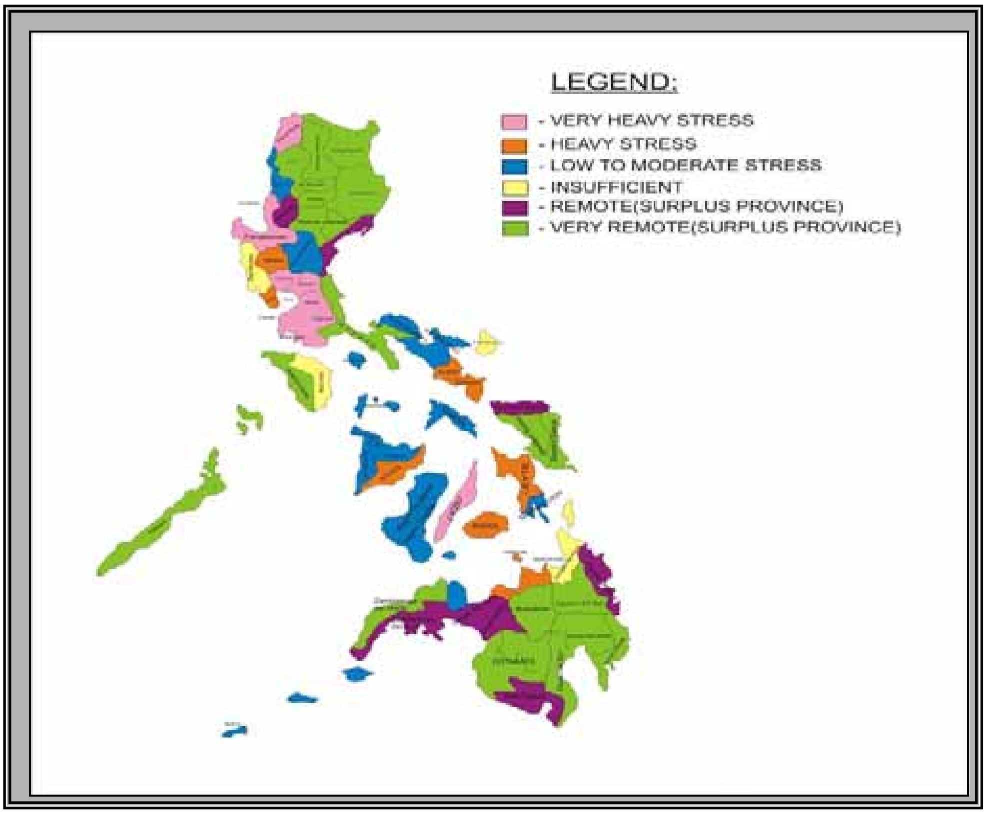
Clearly any effort to develop woodfuel supply estimates over such a large area involves a series of simplifying assumptions and educated guesswork, and the above exercise is no exception. However, what these estimates accomplish for perhaps the first time is to better account for the enormous woodfuel potential of those "in-between" lands that probably make up close to 30 percent of the Philippine land area. Classified as extensive, marginal, brushland, wasteland, or simply "other," these lands have tended to escape the interest of both the forestry community because they could not be considered forest and the agricultural community because they are usually too steep and unsuitable for commercial agricultural purposes. However, these "wastelands" play an essential part in meeting the energy and other subsistence needs of many rural communities. They have come about in different ways ranging from intentional establishment to suppress cogon to natural re-growth in the wake of agricultural abandonment – and they are subject to different management and access rules, but they are a ubiquitous feature of the Philippine countryside. The failure to appreciate their importance in meeting local woodfuel requirements has resulted in repeated predictions of woodfuel deficits at the local (e.g. Cebu, Ilocos) and national level. A more realistic consideration of their woodfuel potential, while even adopting conservative productivity factors of 5–8 t/ha/yr, demonstrates that with perhaps a few local exceptions woodfuel supplies are more than adequate to meet demand throughout the Philippines.

Provincial woodfuel supply-demand scenarios

The aggregate woodfuel demand and supply status may prove to be of less relevance if one considers the fact that if one area has a deficit it can be covered up by another area that has surplus for various obvious reasons. The Philippines, being an archipelago of more than 7 000 islands will entail an enormous road and transportation system not to mention the overall woodfuel flow that may be peculiar on a case to case basis. Hence, it may be meaningless to say that since the surplus areas exceed the deficit areas, the country is in surplus.

Apparently, many areas of the country have a supply surplus while a good number may be experiencing supply deficits. Areas have apparently emerged where local pressures exist due to concentrated local demand. This is more evident in areas with high population density and marginal local woodfuel resources such as the case of Northern Luzon where tobacco-curing industries abound; in mangrove areas and in those areas immediately adjacent to agricultural lands. This therefore suggests that in order to have a more meaningful understanding of the characteristics of woodfuel production systems, a classification of woodfuel demand units will have to be developed for the entire country. Figure 2 shows how this can be done by classifying provinces into various categories such as very heavy stress, heavy stress, low to moderate stress, remote (surplus provinces) and very remote (still surplus provinces). Note that in Figure 3, however, where a glaring comparison of how rapidly the forests is dwindling in a matter of just 10 years.

Figure 2. Philippine map with provincial categorization based on stress level of wood and biomass supply (DAP, 1992)

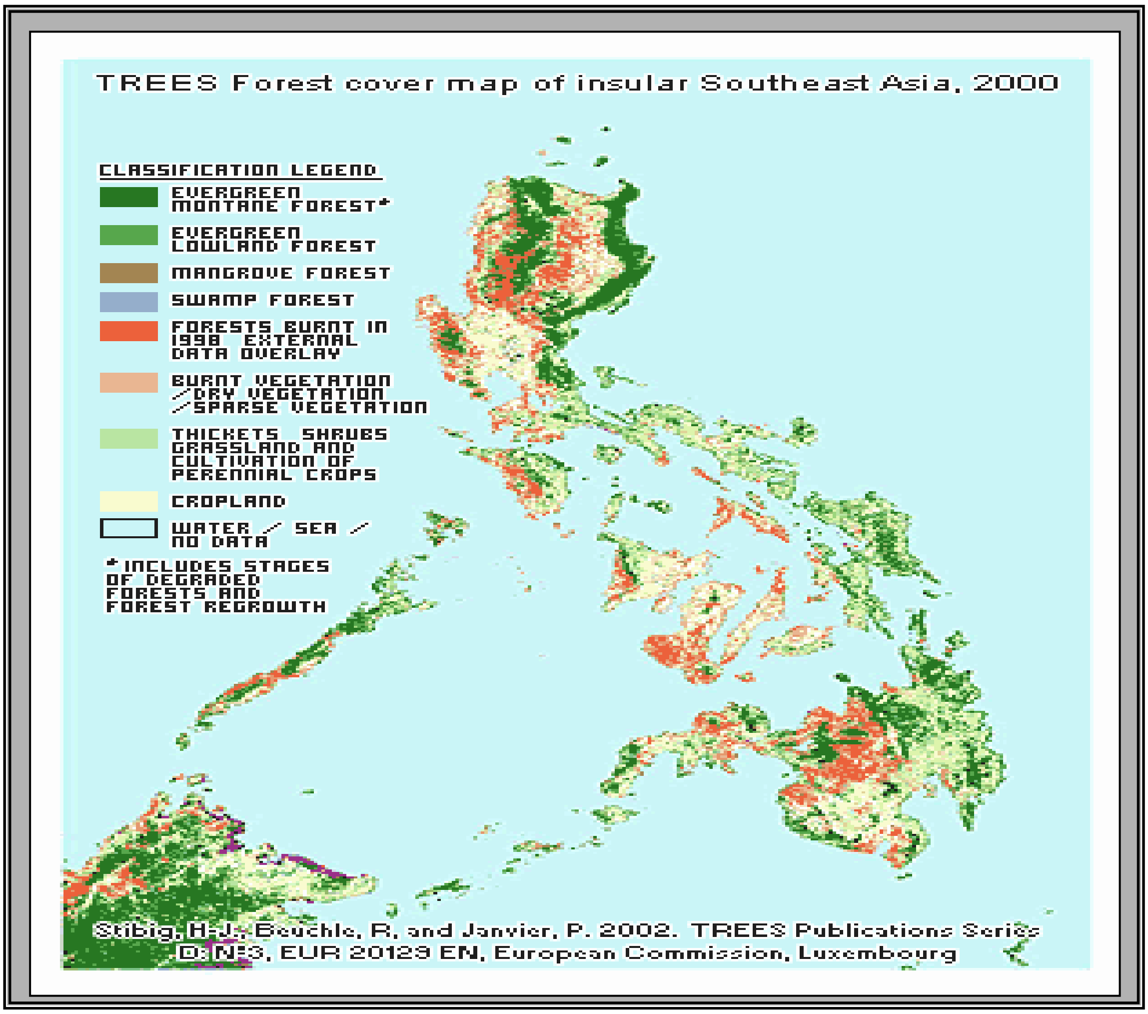


Woodfuel "commoditization" and trading: chain of custody practices

Woodfuels are not only used in the household sector but also by small enterprises such as bakeries, restaurants and food processing industries. As a result of the high demand for fuelwood by the local industries and the incentive for additional income, woodfuel has become an important commercial commodity both as fuelwood and as charcoal. Nera (1998) cited a case in Ilocos region where tobacco and salt making industries use a lot of woodfuel. Local woodfuel shortages brought about by these local industries created a demand for woodfuel not only in the local market but also in the inter-regional market as well.

The study of Arriola (1998) revealed that the market chains of traded woodfuels are not simple, i.e. many rural traders also gather fuel or make charcoal, some gatherers sell fuel directly to urban traders and that there can be several stages in the market chain in the city. The results of her study for the four cities are briefly summed up in the following sections.

Figure 3. SPOT map 2002



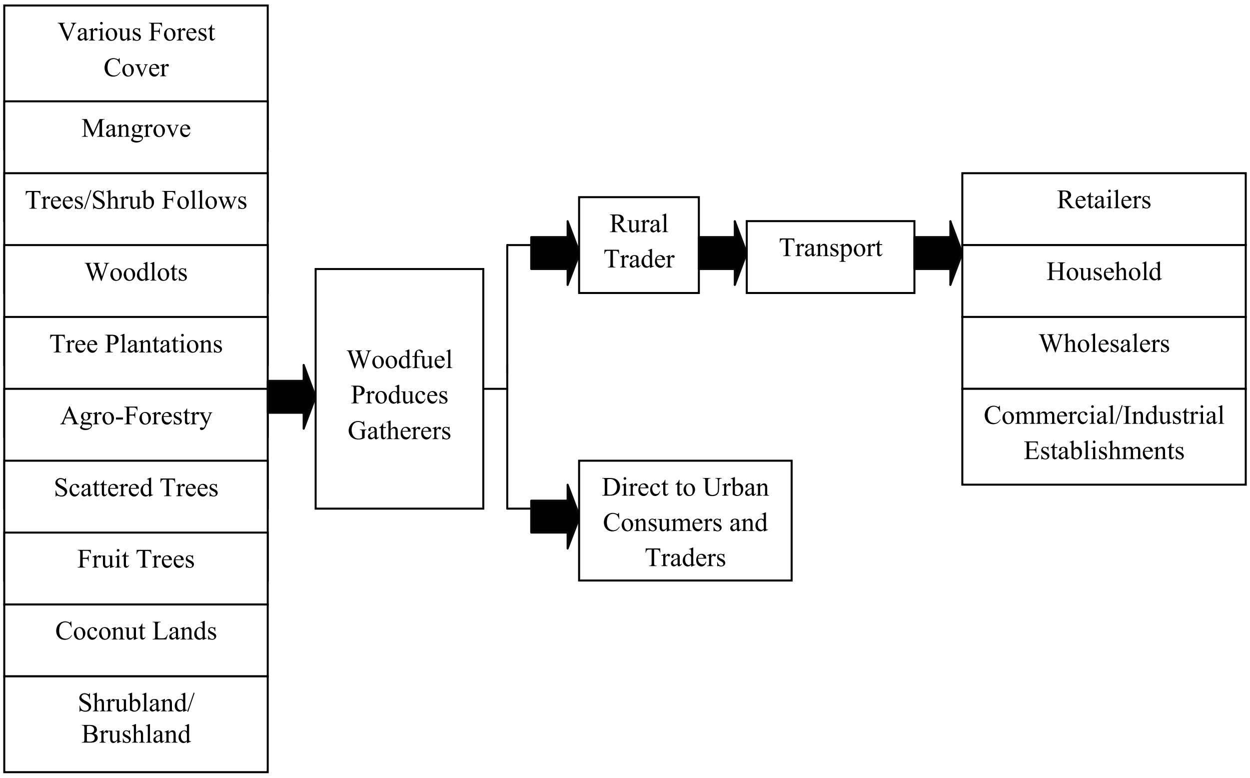
Source: CIFOR, 2003

Cagayan de Oro produced charcoal from coconut shell but an estimate of 70 percent is not used as fuel but purchased by companies for industrial use as activated carbon. The majority of their fuelwood went to household, urban traders, and commercial establishment. The commercial sector in Cebu City accounted 49 and 37 percent of the charcoal and fuelwood consumption, respectively. The barbecue and lechon vendors, restaurants and bakeries are the major users of charcoal aside from household. But charcoal sold to household is reportedly used for ironing and is not for cooking. The fuelwood gatherers in Cebu mostly sell to rural traders who in turn sell it to urban traders, wood-using industries and households. However, the researcher noted important differences of the fuelwood and charcoal markets in Metro Manila from the other urban areas, namely: 1) wood and charcoal are not important fuels in the National Capital Region, 2) transporting fuels require longer distance than those of other regions covered in the study and 3) commercial alternatives are more readily available and cheaper in Metro Manila. Industries and commercial establishment are the major end users of fuel wood (43%). Other fuelwood supply goes to local fuelwood agents or middlemen, wholesalers/retailers and household. The channels of distribution for charcoal supply included retailers, traders, household, transporters and non-fuel uses. In contrast to Metro Manila, household accounted for the biggest share of fuelwood utilization in Tacloban City. The rural traders operated on small-scale basis and considered it as an activity next to farming and shop keeping. Like in Cebu City, charcoal is not an important household fuel for it is only used for ironing or specialized cooking. But the region exports coco charcoal as activated carbon. Fuelwood gatherers sell charcoal to transporters, household and rural traders in the locality. Some also sell directly to the urban traders, bakeries and oil mills in Tacloban City.

There are two types of charcoal produced and marketed in Tacloban, namely coco-shell charcoal and wood charcoal. Coco-shell charcoal makers sell their product to rural traders who at the same time maybe producing their own coco-shell charcoal. From the rural traders, these are distributed to urban traders/retailers and wholesalers in the city or sold directly to household and bakeries while wholesalers sell to activated carbon companies outside Leyte. A simpler distribution channel is followed by wood charcoal product.

Prices of woodfuel products are fluctuating and that there is no evaluation and information campaign on the best species for fuelwood. There is also the absence of standardized unit of measurement and price. Among other things, the participants suggested that provincial/municipal issue ordinances for price standardization. Gatherers may also be formed into cooperatives. Figure 4 depicts the channels of transportation and distribution of commercialized woodfuels. It represents the typical woodfuel flow system and chain of custody. There may be various combinations and modes of layers of distribution from producer to rural and urban wholesalers and retailers before it finally reaches the final consumer. Nonetheless, the flow pattern in general is one represented by Figure 4.

Figure 4. Woodfuel production flow (various sources)



The Cebu Province case study

Environmental impacts of woodfuel production on Cebu

In Cebu, it is believed that over-cutting of trees for local woodfuel needs is the major cause of deforestation and environmental degradation of the island (Seidenschwarz, 1988; DENR, 1991; Osmena, 2001). In fact, the total absence of primary forest in the island was touted to lead to an acute woodfuel shortage. A DENR 1992 report stated:

"*The province of Cebu is now in the stage where firewood is becoming scarce. The situation is so severe that the remaining forest resources are exploited at least three times their sustainable yield. Unfortunately, there are not many fuelwood plantations in Cebu, and if measures are not instituted now e.g. improving conventional fuel distribution networks or massive establishment of firewood plantations, a widespread energy crisis could likely result (p.71).*

Until now, many academicians, government officials, NGOs, continue to perceive that woodfuel production is the major cause in the island province. The island has been labelled a "desert island" an "ecological disaster" (Collins, 1990), an island that is 99 percent denuded (Vesilind, 2002). Yet, over a million rural and urban households continue to get enough supply of charcoal and fuelwood year after year, decade after decade. What could be the reason and what could be the explanation for this inconsistency? Why is there a difference between the perception of many observers from what is actually happening?

Some of the explanation offered by the Cebu studies conducted by Bensel and Remedio (1993, 2003) are: first, much of the supplies come from trees outside forests or TOF. The practice of "coppice" or woodfuels coming from hectares of coppice land has been overlooked or simply misunderstood from the notion of woodfuels produced from “forests.” In Cebu, where the island is only 0.3 percent “forest,” much of the woodfuels are coming from trees and shrubs from woodfuel coppiced lands, woodlots, agroforestry systems and reforestation projects. Pristine primary forest does not exist in Cebu; only secondary growth of shrubs and scattered trees.

Second, there is a failure to understand and appreciate the fact that widespread tree-planting and management practices can actually also happen in private lands and not necessarily from government or NGO operations/interventions. In Cebu, many private upland and hilly-land cultivators and landowners do implement good management of tree-planting and harvest systems notwithstanding government and or NGO interventions.

Last, there seems to be a failure to understand that much of the woodfuel production is done through “coppice” system whereby the trees are cut at the base and allowed to regenerate. Much of the trees used for woodfuel production, firewood and charcoal supplies do come from trees coppiced and regenerate after harvesting.

All told, the commercial demand for fuelwood and charcoal in Cebu’s municipalities and cities is an important incentive for producers to continue planting and practice sustainable woodfuel production system. Cases of indiscriminate cutting may happen from time to time; nevertheless, it is a fact that woodfuel is a thriving livelihood generating employment and incomes to hundreds of households in Cebu for the past decades.

Woodfuel permits

A cutting permit is not required. According to DENR regulations, anyone holding a land title or anyone who can produce a tax declaration for Alienable and Disposable land (land not classified as government forest) can apply for a permit to transport woodfuel products for *planted* trees and shrubs from their land. The fuelwood, charcoal, or other wood products in principle, cannot be transported outside their “lands” without a transport permit.

The process of acquiring a permit first involves the filing of an application, followed by a DENR site visit to calculate the volume of wood products on the land and confirms the status of being “planted.” After the site visit, the applicant pays a fee of around Philippine pesos 100 (approximately US$ 2.00) and indicates the time period when the transporting of the wood products will take place. The “permit” is then issued. This permit is usually valid for only a day so that “recycling” the same permit is avoided.

By implementing this regulation to get a transport permit, illegal cutting of trees from government reforestation sites or from protected areas are addressed. However, in reality the implementation of the said regulation does not always work because of shortage of DENR personnel to police woodfuel matters e.g. the transport permit system. DENR personnel do understand and appreciate the importance and the value of woodfuel production in the province but are just constraint in many ways (i.e. limited staff).

Improving the efficiency of charcoal conversion

Over the years, the demand for charcoal has been increasing and will remain so in the foreseeable future. The question of improving the efficiency of charcoal conversion processes needs to be high on the agenda. Figures 5 and 6 show the *ham-ak* and *tinabonan* highly inefficient methods of producing charcoal compared to the adobe and brick kilns systems. If charcoal efficiency is improved, there can be reduced frequency of cutting trees from coppice lands, increased productivity of charcoal, increased incomes of charcoal makers, and reduced health impacts and air pollution associated with charcoal production.

INSTITUTIONAL, LEGAL AND POLICY FRAMEWORK

Roughly half of the world's population is cooking daily with the traditional biomass including wood and charcoal. Hence, efforts to disseminate improved and more efficient cookstoves are an ideal way to address a wide range of socioeconomic and environmental impacts (Texon, 1998). Energy must be conserved, time spent in collecting woods must be reduced and economic opportunities for both rural and urban families must be increased. Literature also identified that existing policies emphasize multiple-use forest management and that there is no clear-cut guidelines on fuelwood production. Project development programs must therefore address, among others, the woodfuel requirement of the wood-based industries and households.

On the whole, in the Philippines, there is a lack of appreciation of the role of wood energy plays in the economy and the environment and this has reduced the emphasis on energy development in planning and policy formulation (Argete, 1998; Bensel and Remedio, 2002). Argete (1998) also added that the gathering, production and used of fuelwood is unregulated.

The DENR has adopted several policies related to fuelwood utilization and management, such as: (1) Timber Licensee Agreement holders have the privilege of harvesting timber, fuelwood, rattan and bamboo through a permit or lease wherein they are given a maximum of 1 million cubic meters of natural forest species within a year, (2) DENR projects in the upland areas adopt a community-based approach enabling the upland communities to manage the forest resources with minimal government intervention and (3) areas with slopes above 50% with 1 000 meters elevations are considered old growth forests and critical watershed areas and are therefore regarded as prohibited zones. Planting of wood in these areas for fuelwood purposes has to be regulated.

The following institutions are associated with energy:

Department of Energy (DOE) is mandated to ensure a continuous, adequate, and economic supply of energy with the end view of ultimately achieving self-reliance in the country's energy requirements through the integrated and intensive exploration, production, management and development of the country's indigenous energy resources and through judicious conservation, renewal and efficient utilization of energy to keep pace with the country's growth and economic development and taking into consideration the active participation of the private sector in the various areas of energy resource development. DOE is also tasked to rationalize, integrate and coordinate with the various programs of the government towards self-sufficiency and enhanced productivity in power and energy without sacrificing ecological concerns.

National Electrification Administration (NEA) is a government-owned and controlled corporation primarily tasked to undertake rural electrification programs on an area coverage basis. The NEA is given the responsibility to establish rural electric cooperatives for the generation, transmission and distribution of electric power and also to determine privately-owned public utilities which should be permitted to remain in operation in order to attain total electrification of areas not covered by NPC grids.

Figure 5. Charcoal maker using *ham-ak* (aboveground) method. Barangay Sinsin, Cebu City (Bensel Terrence, 2003).

Figure 6. Charcoal maker using the *tinabonan* method (Underground approach) Barangay Pamutan, Cebu City (Bensel Terrence, 2003).

Energy Regulatory Board will promote and protect long-term consumer interests in terms of quality, reliability and reasonable pricing of a sustainable supply of electricity. Hence, its functions are associated with promulgation, enforcement, promotion and resolution of matters pertaining to regulations, guidelines, policies, disputes, consumer interests, among others.

National Power Corporation is the authorized implementing agency responsible in setting up transmission line grids and the construction of associated generating facilities in Luzon, Visayas and Mindanao and major islands in the country. The ultimate goal of NPC is to achieve the total electrification before the 21^{st} century. For such ambitious plan, NPC envisions the interconnection of all-independent grids in Luzon, Visayas and Mindanao through the advanced system of overhead lines and submarine cables.

National Transmission Corporation is a government-owned and controlled corporation that has assumed the electrical transmission functions of the National Power Corporation in the major Philippine grids. It was created by the virtue of Republic Act 9136 or the Electric Power Industry Reform Act of 2001.

Department of Environment and Natural Resources (DENR) is the lead agency mandated to conserve, manage, develop and use properly the country's natural resources and environment particularly the forest, grazing and mineral resources, including watershed reservation and national parks. As such DENR has jurisdiction overall forest lands, grazing lands, mineral reservations, national parks, forest reserves and watershed reservations.

Department of Agriculture (DA) is mandated to support development through the provision of policy framework, public investment and support services needed for domestic and export-oriented agricultural enterprises. In line with this mandate is the improvement of farm income and creation of employment opportunities for farmers, fishermen and other rural workers.

Department of Agrarian Reform (DAR) is the lead agency mandated to implement the Comprehensive Agrarian Reform Program on all private agricultural lands, regardless of tenure or commodity produced and also to include selected areas of the public domain.

Department of Science and Technology (DOST) is mandated to formulate and implement policies, plans and programs, and projects for the development of science and technology and for the promotion of scientific and technological activities for both the public and private sectors and ensure that the results of these activities are properly applied and utilized to accelerate economic and social development.

The Need for a Comprehensive Woodfuel Policy Program. Back in 1992 (DAP), the following described the status of fuelwood and/or woodfuel program in the country. To date, 2007, little has changed:

- Woodfuels play a prominent role in both rural and urban areas of the economy.
- Woodfuels are important in rural industries such as bakeries, restaurants, and flue curing for tobacco.
- Despite the existence of various agencies dealing with wood energy, there is as yet, no comprehensive policy on fuelwood and or woodfuels.

- The Department of Energy is tasked with the formulation, planning, monitoring, implementation and coordination of policies and programs in the field of energy. While it has projects designed to promote the use of non-conventional energy, the department itself has no definite program on woodfuel. This may be understandable because land jurisdiction of woodfuel is vested not with the Department of Energy but with other agencies such as the Department of Environment and Natural Resources and the Department of Agriculture. As such, DOE lumps woodfuel in the more general term agri-waste as a source of non-conventional energy.
- DENR, under Executive Order No. 192 is tasked with the conservation, management, development and proper use of the country's environment and natural resources.
- With the alarming environmental state of the country, along side rural poverty in the uplands, DENR has tasked itself with massive reforestation of denuded areas under the National Forestation Program and has continued to make Integrated Social Forestry Program a priority program designed to contain the further destruction of the forests by the upland dwellers and at the same time provide them with opportunities to improve their lot.
- These two big programs offer opportunities for woodfuel development. Under the National Forestation Program, some 436 000 hectares or 31 percent of the 1.4 million hectares target goal has been earmarked for fuelwood. Under the ISF Program, DENR Administrative Order No. 28 series of 1989 mandates participants to develop at least 20 percent of their land to tree farming. In 2003, CIFOR reported the following:

This program was given a boost by the ADB/OECF loan for $240 M in 1988 for what became the Forestry Sector Project. Under this project, traditional methods of reforestation gave way to contract reforestation by families, communities, corporations, academic institutions, NGOs and LGUs. It also included watershed rehabilitation and encouragement of industrial reforestation through new agreements.

The 1990s continued to see numerous community-based and integrated development projects funded by ADB, JBIC, World Bank, ITTO, FAO, KFW and others; and executed by the state, NGOs, LGUs, and people's organizations. Community-based forest management through different types of tenurial instruments was adopted as the national strategy for reversing the destruction of Philippine's remaining natural forests and for rehabilitating degraded lands. Besides social and community forestry, reforestation activities have also included large-scale government and industrial plantations and private tree farming. The latter has cropped up spontaneously in response to market demand, particularly in Mindanao, Luzon, and Cebu. It has been suggested that private land reforestation in the last decades may have actually led to increased forest cover in places. New forest cover inventories that are underway could help clarify the situation. There have been a wide range of players involved in forest rehabilitation in the Philippines in the last few decades including the national government, NGOs, private companies, LGUs, local communities and private land owners. Approaches have been equally diverse with expansion from traditional large-scale government reforestation projects and industrial tree plantations to contract reforestation, community-based initiatives, integrated development and livelihood projects, agroforestry, and private tree farming. Results have been mixed with some promising cases and others not quite so in each of the approaches, depending on the circumstances. Also in general, some approaches such as private tree farming have been more popular and rapidly adopted than others. Ensuring long-term sustainability appears to be one of the biggest challenges facing many of the initiatives. Most evaluation is based on target areas and survival rates of plantings, and often little is known about the environmental and socio-economic impacts (CIFOR, 2003).

- While the above programs and other tree planting activities of DENR including thinning of natural and plantation forests contribute to wood energy, there is no single, purposive project on fuelwood on a national scale.
- In terms of organization, there is as yet no entity directly managing or supervising or coordinating fuelwood related projects. At the time when FAO-RWEDP was active, a National Coordinating Committee and a Technical Experts Group was formed under the DENR. Now, these are defunct.
- Given the scenario that fuelwood will continue to be the energy for the future, it is but appropriate that the government needs to formulate a national policy on fuelwood and develop programs purposely for fuelwood. It is necessary that the various organizations should be in place to lead and coordinate the various activities of the fuelwood program.

CURENT EFFORTS TOWARDS WOODFUEL PRODUCTION, MANAGEMENT, DEVELOPMENT AND SUSTAINABILITY

After a lengthy discussion of the woodfuel situation in the country, it is clear that there are two major institutions that need to take the lead in woodfuel production systems. One is the Department of Energy (DOE) and the other is the Department of Environment and Natural Resources (DENR). They both differ however in what particular chain of custody they need to be responsible for vis-à-vis woodfuel production and management systems. In the case of the Department of Energy, residential sector use and even industry use for woodfuels has taken a very minimal priority. This is because the focus is in the other types of renewable resources that need to be developed and has a greater potential. Biomass resources; however, has taken a more serious consideration relative to woodfuels (for instance the Biofuel Law recently approved). Below is a comprehensive discussion of the current treatment of woodfuels relative to the other types of renewable energy.

Current efforts of the Department of Energy in relation to woodfuel production

A Philippine Country Paper on the Utilization of Renewable Energy was presented recently (Kathmandu, Nepal, December 2006) by Dante Castillo and Enrique Navarrete (both from the Department of Energy, Philippines). In that paper, a comprehensive discussion about the direction of renewable energy vis-à-vis woodfuels (and biomass) production systems can be gleaned from. They start out with a clear energy sector agenda that is towards an aggressive development of renewable energy potential such as biomass, solar, wind and ocean resources.

According to the report, imported oil remained as the major source of energy, although its share in the total energy supply declined 45.5 percent in 2000 to 34.8

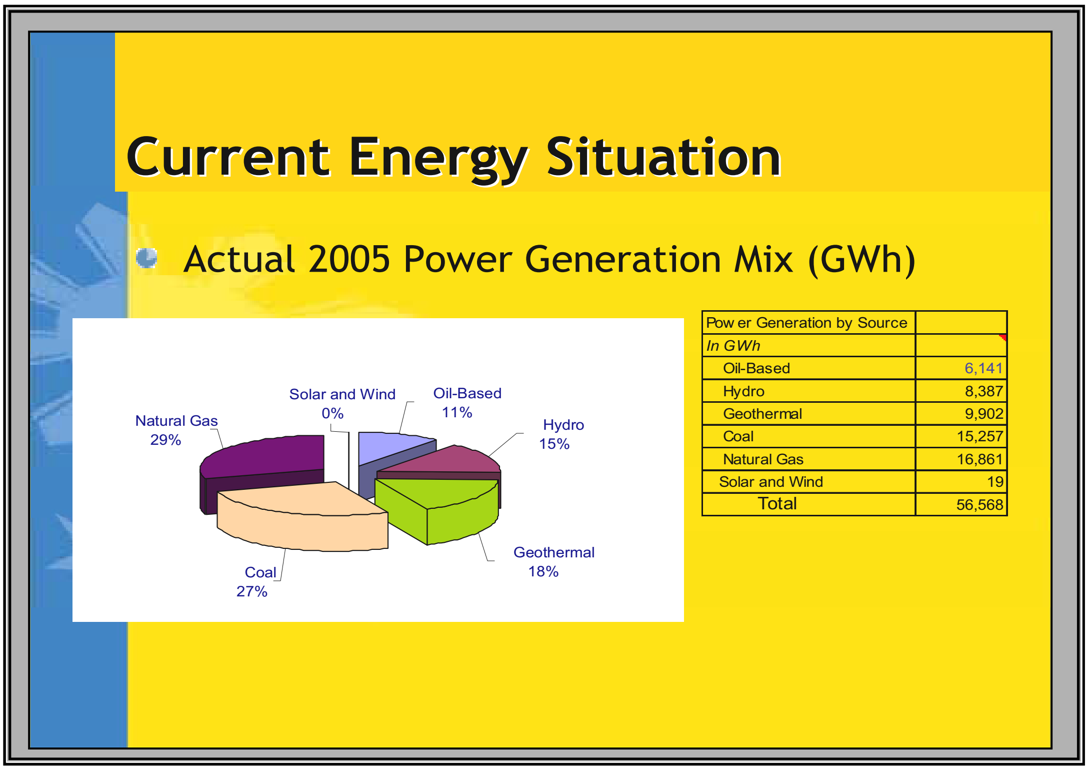
percent in 2005. Renewable energy, in particular biomass contributed about 17 percent to the total primary energy. The natural gas contributed to as high of 6.5 percent in 2005 and this was attributed to the improved production of Malampaya field. The energy self-sufficiency level stood at 56 percent.

Further, it notes that there are at least nine (9) types of energy sources or available power plants serving the country needs of power and these are the following: coal, oil thermal, diesel, gas turbine, geothermal, hydropower, natural gas and renewable energy (wind and solar). Figure 7 shows the actual 2005 power generation mix. Understandably, there is no mention of woodfuels, except that of biomass resources for biofuel.

In the Residential Sector, the total energy consumption of the residential sector in 2004 grew by 6.0 percent to 52.1 MMBFOE (7.5 MTOE). Biomass accounted for 67.0 percent of the total residential energy consumption. Demand for petroleum products, specifically liquefied petroleum gas (LPG) and kerosene used primarily for cooking declined by 5.9 percent due to fuel switching as an effect of soaring prices of these fuels. Household electricity consumption increased by 3.7 percent.

In terms of Final Energy Demand, energy consumption is primarily influenced by economic growth, population, fuel prices, incomes and supply accessibility. These indicators were used in forecasting the country's final energy demand for the 2006 Plan Update. The demand forecast was done on a sectoral basis to include the transport, residential, industrial, commercial and agricultural sectors. Final energy demand in this 2006 Plan Update shows a lower forecast in almost all sectors in contrast to the Reference Plan taking into account moderate growths in 2004 and preliminary 2005 energy consumption data. In addition, the conduct of the HECS in 2004 firmed up data on biomass consumption in the residential sector. Initial results of the survey indicate that biomass consumption by the household sector is significantly lower than the previous estimates.

Figure 7. Current energy situation 2006



Pow er Generation by Source	
In GWh	
Oil-Based	6,141
Hydro	8,387
Geothermal	9,902
Coal	15,257
Natural Gas	16,861
Solar and Wind	19
Total	56,568

In this 2006 Plan Update, the country's energy demand for the planning period is estimated to grow by 3.3 percent. The projected growth in energy demand will be sluggish compared to the projected 5.0 percent growth in the Reference Plan. Demand by the transport sector takes into account the fuel consumption of the different types of vehicles used for land, air, and water. The energy consumption of the transport sector will post an average growth of 3.5 percent. Petroleum products will remain as the dominant fuel for transport use. Meanwhile, demand for biofuels (CME and ethanol) is seen to increase by 4.4 percent annually across the planning period.

The residential sector will be the second largest user of energy among the different end use sectors, accounting for an average share of 28.9 percent to the country's total energy demand. Total residential energy demand is estimated to grow at an average annual rate of 1.4 percent. Biomass will remain as principal fuel in the residential energy requirements. However, in terms of quantity, household biomass consumption will slide down by 0.6 percent on the average due to fuel switching in cooking and lighting based on the 2004 HECS. The use of fuelwood and charcoal as major biomass fuel for cooking will decline as households shift to more efficient and convenient fuels such as LPG and electricity.

The Department is mandated by RA 7638 (Department of Energy Act of 1992) to prepare, integrate, coordinate, supervise and control all plans, programs, projects and activities of the Government relative to energy exploration, development, utilization, distribution and conservation. Hence, the government's policy towards renewable energy is a favourable one. Moving forward to the shift from fossil fuels to renewable energy, the Department of Energy has embarked on the law that will create an investment climate and will explore the use of the countries unexplored renewable energy thereby giving a chance for the private investors to participate. This gave birth to the Renewable Energy Policy Framework which is now on its final reading and approval in the Senate.

Interestingly, the report highlights biomass as the main type of renewable energy resource in the country. According to the report, the Philippines has an abundant supply of biomass resources, such as agricultural crop residues, forest residues, animal wastes, agro-industrial waste, municipal wastes (about 60% of which is biomass) and aquatic biomass among others. Fuelwood for households and fuelwood for industrial uses are mentioned (Table 11). Technologies to convert biomass into energy were already available since early seventies as a result of private initiative and government support. Through the years, biomass has contributed significantly to the national energy mix.

Biomass, solar and wind will be among the major sources of energy for the next decade, accounting for more than a third of the country's total energy demand. From 81.5 MMBFOE (Millions of Barrels in Fuel Oil Equivalent) in 2003, the absolute level of these sources will increase by 2.8 percent annually reaching 104.1 MMBFOE in 2012. Biomass will continue to take the lion's share of the total at 99 percent. Meanwhile, the contribution of solar, wind and ocean will reach 0.6 MMBFOE in 2003 rising to 1.7 MMBFOE in 2007 and 3.0 MMBFOE in 2012.

Table 10. Renewable energy goals, policies and strategies

Energy Sector Objectives	RE Goals	RE Policies and Strategies
Ensure sufficient, stable, secure, accessible and reasonably-priced energy supply Pursue cleaner and efficient energy utilization and clean technology adoption Cultivate strong partnership and collaboration with key partners and stakeholders Empower and protect welfare of various energy publics	Increase RE-based capacity by 100% by 2012 ➢ Be the number one geothermal energy producer in the world ➢ Be the number one wind energy producer in Southeast Asia ➢ Double hydro capacity by 2012 ➢ Expand contribution of biomass, solar and ocean energy by 100MW Increase non-power contribution of RE to the energy mix by 10MMBFOE in the next ten years	Diversify energy mix in favour of indigenous RE resources Promote wide-scale use of RE as alternative fuels and technologies Transform Negros island as a model of RE development and utilization Make the Philippines the manufacturing hub for PV cells to facilitate development of local manufacturing industry for RE equipment and components Encourage greater private participation in RE development through market-based incentives Establish responsive market mechanisms for RE generated power Formulate an effective management program for fuelwood utilization with the view of reducing environmental impact

At present, biomass technologies utilized in the country vary from the use of bagasse as boiler fuel for cogeneration, rice/coconut husks dryers for crop drying, biomass gasifiers for mechanical and electrical applications, fuelwood and agri-wastes for oven, kiln, furnace and cookstoves for cooking and heating purposes.

Contribution of biomass, wind and solar sources for non-power applications will comprise a large portion of total demand for RE in the next ten years. Demand for solar and wind energy sources is foreseen to grow with the implementation of the program to invigorate the market for solar water heaters and locally fabricated solar dryers and wind pumps. On the other hand, biomass resources will continue to dominate total non-power demand for RE, increasing from 40.43 MMBFOE in 2003 to 47.46 MMBFOE in 2012.

Table 11. Summary of biomass and other renewable resources in the Philippines (in MMBFOE)

RESOURCE	200	2007	2008	2009	2010	2011	2012
Wind	0.7	0.7	0.7	0.7	0.7	1.1	1.1
Solar	0.4	0.4	0.5	0.5	0.6	0.8	0.8
Ocean	0.5	0.5	0.5	0.5	0.5	1.1	1.1
Biomass	87.4	89.5	91.8	94.1	96.9	100.7	101.1
Animal Waste	0.5	0.6	0.7	0.7	0.8	0.9	1.0
Municipal Solid Waste	0.4	0.4	0.4	0.5	0.5	1.3	1.3
Bagasse	12.4	12.7	13.0	13.3	13.6	13.9	14.1
Coconut Residue	13.4	13.7	14.1	14.4	14.8	15.1	15.5
Rice Residues	5.8	6.0	6.2	6.4	6.6	6.9	7.1
Fuelwood (Household)	42.8	43.6	44.3	45.1	45.9	46.7	47.5
Fuelwood (Industrial)	6.1	6.5	6.9	7.3	7.9	8.8	8.2
Charcoal	5.8	5.9	6.1	6.6	6.6	7.1	6.4
Total	**89.0**	**91.2**	**93.5**	**95.9**	**98.7**	**103.6**	**104.1**

The household sector will remain the largest user of these energy forms particularly fuelwood, comprising 66.9 percent of the total biomass consumption for the ten-year period. From a level of 57.6 MMBFOE in 2003, consumption of the sector will increase to 68.4 percent in 2012. While there is a growing trend in the consumption of fuelwood in the next ten-year period, the government shall institute measures and programs that would rationalize the utilization of this resource, with the view of reducing the negative impact on the environment. Such measures and programs to be instituted would include but not limited to the use of LPG and electricity for cooking and solar driers for crop drying, which would encourage rural households to shift to alternative fuels. Biomass will still be the most important fuel for rural households particularly in their cooking and agriculture activities such as crop drying.

Role of the Philippine Department of Energy in promoting renewable energy through biomass

It is the Philippine government's policy to facilitate the energy sector's transition to a sustainable system with Renewable Energy, particularly biomass, as an increasingly prominent, viable and competitive fuel option. The shift from fossil fuel sources to renewable forms of energy is a key strategy in ensuring the success of this transition. Moreover, current initiatives in the pursuit of this policy are directed towards creating a market-based environment that is conducive to private sector investment and participation and encourages technology transfer and research and development. Thus, current fiscal incentives provide for a preferential bias to RE technologies and projects which are environmentally sound. It is the specific objectives of the government to:

- To increase RE-based capacity by 100% by 2013
- To be the number one geothermal energy producer in the world
- To be the leading wind energy producer in Southeast Asia
- To double hydro capacity by 2013
- To increase non-power contribution of RE to energy mix by 10 MMBFOE in the next 10 years
- To become a regional solar manufacturing export hub
- Expand contribution of biomass, solar, micro-hydro and ocean by 250 MW
-

In view of the above, the Department of Energy has in fact, in collaboration with our legislators, passed and finally legislated the Biofuels Act that obligates all gasoline and diesel fuel sellers to blend in up to 10% ethanol and 2% Coco-Methyl Ester (CME) their products, respectively. On the other hand, the renewable energy bill (house bill 5563) is slated for final reading and approval by the bicameral committee. Once approved, it will pave the way to the following salient features:

- Renewable Energy Portfolio Standards (RPS) that will directly impose having a minimum amount of RE-based energy for all generators of electricity.
- RPS levels will be set on a grid to grid basis.
- Establish a Renewable Energy Market linked to the bigger Wholesale Electricity Spot Market to ensure compliance thru assigning a RE Registrar.
- Provides end users to choose clean, renewable and alternative energy as a concrete step towards RE promotion.
- Require the national power provider, NAPOCOR, and other new power providers in off grid areas (such as small island groups) to source a minimum percentage of their generation from available RE sources in their area, including biomass.
- Adopt net metering and distributed generation.
- Reduce government share in gross revenues.
- Provide fiscal incentives such as income tax holidays.
- Establishment of a trust fund for the research, development and promotion of RE.

As an aggressive move to promote RE development and use, the DOE has identified long-term goals, namely, to (1) increase RE-based capacity by 100 percent by 201 and (2) increase non-power contribution of RE to the energy mix by 10 million barrels of fuel oil equivalent (MMBFOE) in the next ten years. In support of these general goals, the government aims to (1) be the number one geothermal energy producer in the world, (2) be the number one wind energy producer in Southeast Asia, (3) double hydro capacity by 2013 and (4) expand contribution of biomass, solar and ocean by about 131 MW. These goals serve as concrete benchmarks for government to advance its vision of a sustainable energy system with RE taking a prominent role in the process. As mentioned earlier, aside from DOE, the Department of Environment and Natural Resources should also be a major government agency taking a stakeholders view in regard woodfuel production systems. Below is the discussion.

The Philippine set of criteria and indicators for sustainable forest management (SFM)

The Philippines has adopted the concept of Sustainable Forest Management as its major policy thrust in order to assure the long-term stability of its forest resources. In 2003, several consultations were done and later in the year, the DENR produced a document entitled "The Philippine Set of Criteria and Indicators for Sustainable Forest Management: A Manual and Reporting Framework."

In that document, DENR documented its experience in coming up with a set of criteria and indicators for SFM. The output of which will be elaborated in the succeeding sections of this report. A similar trajectory may be proposed for woodfuel production system inasmuch as during the course of data collection for this Paper, it was found out that in reference to the C&I, whatever is present at the national level, should also be felt at the Forest Management Unit (FMU) where woodfuel production take place.

According to this document (DENR, 2003), the policy of SFM is largely attributable to the implementation of measures embodied in the 1987 Constitution, the Philippine Strategy for Sustainable Development and the Philippine Agenda 21, the Master Plan for Forestry Development, and the adoption of the community-based forest management and watershed/ecosystem approaches as the main strategies for SFM. These key measures have been supported by various bilateral and multi-lateral funding agencies that supported various policy and institutional reforms and major forestry programs.

Further, the Manual on C&I comprehensively describes (full text from the DENR website: April 2007) the context of the efforts. For instance, to assess the current state of SFM in the Philippines, it is necessary to have a full understanding of the various components of SFM and their impacts on forest resources and ecosystems. These require a system of measurable criteria and indicators to evaluate the changes and conditions and management systems at national and forest management unit levels like timber concessions, industrial forest management areas, and community-based forest management areas. In this context, the DENR through the FMB is implementing the Project "PD 225/03 Rev. 1(F)" funded by the International Tropical Timber Organization. The project aims to adopt and implement an appropriate system of criteria and indicators based on the ITTO model. The adopted C&I will be applied as management tools for reporting progress towards SFM and enhancing capability of FMUs in managing their forest resources on a sustainable basis.

A pre-test was done for the Philippines. The Philippine C and I system, developed under a Pre-project [PPD 29/01 Rev. 1 (F)] also supported by the ITTO, was pre-tested in selected FMUs in the country and presented in a series of consultations and discussions with forest managers, non-governmental organizations, academic institutions, peoples' organizations, other government agencies and other civic society groups. The system will be used for national and FMU levels of reporting progress to SFM, identification of key factors hampering advancement, and proposing remedial measures to achieve goals and targets on SFM and Objective 2000. It was adopted in principle for implementation during a high-level meeting of DENR and other agencies' top officials held last November 2004. The results will be presented in the latter portion of this paper.

Among the objectives of the ongoing ITTO-FMB project aside from adoption of the C&I system, is the formulation and implementation of an appropriate audit system for the country using the C&I for SFM resulting from the pre-project. The system will be meaningless if not applied along with auditing of the adopted C&I to be used by various FMUs including CBFM areas as a tool for SFM reporting, control, verification, and monitoring.

The ITTO and the Philippine criteria and indicators

The International Tropical Timber Organization (ITTO) pioneered the development of criteria and indicators for SFM. It formulated an innovative forest management tool, one of the ongoing nine global processes, applicable mainly to Tropical forests. ITTO's Criteria and Indicators were originally formulated in 1991 as part of the Organization's pioneering policy work. The ITTO C&I were revised in 1998 to take account the numerous developments in ITTO and internationally after UNCED in 1992, including publication of a set of related policy guidelines by ITTO and the development of parallel C&I processes for temperate and boreal forests.

Back in 1998, ITTO has embarked on an unprecedented initiative to provide training to countries on the use of the C&I for monitoring, assessing and reporting on forest management, with the overall objective of promoting wide-scale implementation of the C&I in producer member countries. These countries now report to the Organization on the status of their forest management using the C&I via Reporting Formats (at the national and forest management unit – FMU – levels) developed and approved in 2001. ITTO's experiences in C&I training and reporting have provided valuable insights into the use of this tool. ITTO has also co-sponsored, with FAO and others, a series of international expert meetings on C&I to help to foster their uptake at a global level. In 2003, the International Tropical Timber Council [ITTC Decision (XXXVII)/17], taking into account all of these developments, decided to undertake further revisions of the ITTO Criteria and Indicators and Reporting Formats, simplifying the system and retaining the seven criteria with some modified language and the indicators were reduced from 63 to 56 and the reporting requirements from 89 to 56. This new C&I system was adopted by the 37th Session of the ITTC held last 13–18 December 2004 in Yokohama.

The objective of ITTO's Criteria and Indicators is to provide member countries with an improved tool for assessing and reporting on changes and trends in forest conditions and management systems at the national and forest management unit levels. By identifying the main elements of sustainable forest management, the criteria and indicators provide a means of assessing progress towards sustainable forest management that is "to enhance the capacity of members to implement a strategy for achieving exports of tropical timber and timber products from a sustainable management of their resources." The information generated through these Criteria and Indicators in assessing the state of the forest will help communicate the status of efforts towards sustainable forest management more effectively. It will also assist in developing strategies for sustainable forest management, in focusing research efforts where knowledge is still deficient and in identifying weaknesses.

When the indicators are made operational, a sound basis would be created for measuring sustainable forest management. The ITTO Criteria and Indicators should serve as a framework within which each country can develop its own system for determining sustainability at the national and forest management unit level. While the overall sustainability of the management of a nation's forests depends substantially upon actions taken at the national level (such as decisions on the balance of land use between forestry and other land uses and, within forestry, between production, conservation and protection), analysis at the forest management unit level is the key to monitoring and assessing sustainable forest management. Analysis at the national level for many indicators is carried out by aggregating the results of FMU level indicators. The wide variability of size and administrative/ownership structures of forest management unit's means that the level and nature of aggregation required will vary greatly between countries.

All the criteria are valid at both the national level and the level of the forest management unit. In the case of the indicators, some do not apply at the FMU level. A *criterion* is defined as an aspect that is considered important by which sustainable forest management may be assessed. A criterion is accompanied by a set of related indicators. A criterion describes a state or situation which should be met to comply with sustainable forest management. An *indicator* is defined as a quantitative, qualitative or descriptive attribute that, when periodically measured or monitored, indicated the direction of change.

Countries face a considerable burden in reporting to different international organizations. This load can be eased by ensuring that the nature of the data requested is as similar as possible. Indicators have, therefore, been chosen so as to be compatible with internationally agreed standards and definitions, as far as possible. If the indicators are to give an accurate picture of trends, it is important that comparable methods are used between one assessment and the next; and that there should be a means of estimating the degree of accuracy of any data presented. Ideally, countries should use the same methods of measurement and assessment over time. However, data collection and analysis techniques are dynamic. Countries in each report give a description of the methods used and an estimate of the accuracy of their figures and any difficulties encountered in their collection.

The Philippine C&I system is a systematic adaptation of the ITTO model refined under the country's forestry situation. The criteria and indicators in the country's context are a product of consultations among relevant government agencies and forest stakeholders. The purpose of the Philippine set of criteria and indicators is to provide the government through DENR and forest managers within the country an improved tool for assessing changes and trends in forest conditions and forest management systems. The criteria and indicators will also provide means of assessing progress towards the attainment of the objectives set under Executive Order 318 otherwise known as "Promoting Sustainable Forest Management in the Philippines" and towards to the commitment to ITTO Objective.

The use of the criteria and indicators as management tools will provide the forest managers a framework for understanding, planning and implementing improved forest management technique. They will have enhanced capacity to comprehensively assess the situations of their forest management units whether they are moving towards or away sustainable forest management. This will also help policy and decision makers in developing policies and necessary actions to further strengthen SFM, focusing on aspects where knowledge is still deficient and in identifying those areas which are in need of assistance.

The criteria identified by the ITTO were adopted as elements of sustainable forest management in the Philippines. Every criterion was accompanied with a full meaning and description as to what this particular criterion pertains.

Criterion 1. Enabling Conditions for Sustainable Forest Management covers the general institutional requirements for sustainable forest management to succeed.

Criterion 2. Extent and Condition of Forests, deals with Forest Resource Security relates to the extent to which the Philippines has a secure and stable forest state to meet the production, protection, and other social, cultural, economic and environmental needs of the present and future generations.

Criterion 3. Forest Ecosystem Health relates to the condition of the country's forests and the healthy biological functioning of its forest ecosystem and it deals with the forest conditions and health as affected by a variety of human actions and natural causes.

Criterion 4. Forest Production deals with the production of wood and non-wood forest products with perceptions that production can only be sustained in the long-term if it is economically and financially viable, environmentally sound and socially acceptable.

Criterion 5. Biological Diversity, relates to the conservation and maintenance of biological functioning of the forests.

Criterion 6. Soil and Water Protection, deals with the protection of soil and water in the forest.

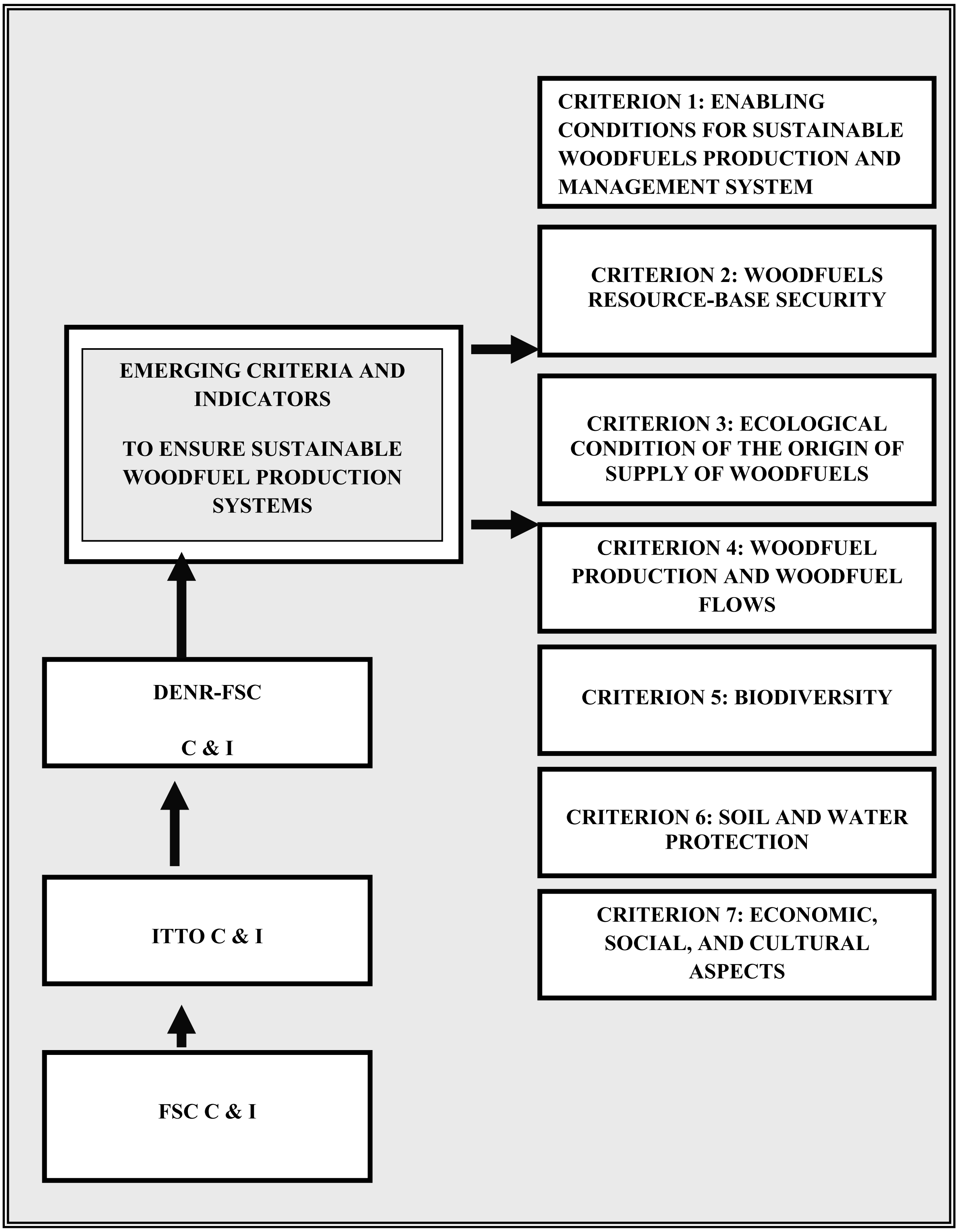
Criterion 7. Economic, Social, and Cultural Aspects, relates to the economic, social and cultural function of the forest.

The indicators have been carefully and comprehensively assessed and identified through a series of consultations with the different stakeholders to fit in the situation of the Philippine forestry setting.

Criterion 1 has a total of eleven (11) indicators and mainly descriptive in nature. Criterion 2 is composed of six (6) indicators. In Criterion 3, there are two (2) indicators identified. Criterion 4 has a total of ten (10) indicators that were designed relate to the flow of forest produce. There are a total of seven (7) indicators that were identified in Criterion 5. Criterion 6 is composed of five (5) indicators and a total of twelve (12) indicators identified for Criterion 7. A total of 53 indicators compose the Philippine C&I. These are all applicable at the national level. At the FMU level 47 indicators are considered appropriate for the Philippine forestry situation.

The Philippine C&I therefore is applicable to all forest conservation and forest products including NWFPs development efforts at the national and at the FMU level with the end view of sustainability using the SFM concept. Woodfuels that is fuelwood and charcoal are part of this framework. However, whenever woodfuels originate from private lands or are gathered for free from land uses such as private woodlots, or family woodlots, among others, the Philippine C&I can only be applicable when the country implements SFM through forest certification. The trading of certified charcoal and or certified fuelwood will have to be a public sector move otherwise, a more comprehensive monitoring of chain of custody for woodfuels, for instance at the transportation level, will suffice as the main recommendation. It is not possible to monitor fuelwood that is gathered for free among households. It is also not possible to monitor ultra small-scale charcoal production activities which are happening at a massive volume particularly if these are done at a subsistence level meant only for household consumption.

Figure 8. Criteria and Indicators for sustainable woodfuel production and management framework



Principles, criteria and indicators for sustainable woodfuel production and management framework

Below is an attempt at culling a criteria and indicator framework for woodfuel production. A criterion is defined as "an aspect that is considered important by which SFM may be assessed." A criterion describes a state or situation which should be met to comply with sustainable forest management, and in this case, a sustainable woodfuels production and management. Using the Philippine C&I for SFM (DENR Manual, 2007) as the main framework, below are 7 Principles, 7 Criteria, 53 Broad Indicators, and 183 Specific Indicators.

PRINCIPLE 1: **Enabling conditions for sustainable woodfuels production and management systems exist**

To ensure sustainable forest management vis-à-vis woodfuel production systems, it is important that the woodfuel resources, especially permanent forest estate are secured and protected and that they are managed in accordance with best management practices involving all stakeholders, in particular and local communities who are dependent upon the forest, in general.

CRITERION 1: Enabling conditions for sustainable woodfuels production (SWP)

Indicator 1.1 Existence and implementation of policies, laws and regulations to govern woodfuels production and management.

- *National objectives for forests vis-à-vis woodfuels management including production, conservation, protection and investment*
- *The establishment and security of woodfuel plantations*
- *Forest tenure and property rights in relation to forests*
- *Participation of local communities and other stakeholders in forest management*
- *Control of illegal activities in forest areas in relation to woodfuel production and trade*
- *Control of forest management vis-à-vis woodfuel production and trade*
- *The health and safety of forest workers in general and woodfuel producers in particular.*

Indicator 1.2 Extent of forest tenure and ownership of forest vis-à-vis woodfuel production.

Indicator 1.3 Amount of funding in woodfuel management, administration, research and human resource development.

- *Government sources (national, sub-national)*
- *International development partners (grant, loan)*
- *Private sources (domestic, foreign)*

Indicator 1.4 Existence and implementation of economic instruments and other incentives to encourage sustainable woodfuel production systems.

Indicator 1.5 The structure and staffing of institutions responsible for SFM vis-à-vis woodfuel production systems.

- *Primary government agency in-charge*
- *Nature of responsibilities*
- *Number of staff*

- *Website addresses*
- *Other institutions*
- *Nature of responsibilities*
- *Number of staff*
- *Website addresses*

Indicator 1.6 Number of professional and technical personnel at all levels to perform and support woodfuel management.

- *Government (professionals, trained forest/woodfuel workers/specialist, others - Full time or Part time, Number)*
- *Non-government (professionals, trained forest/woodfuel workers/specialists, others - Full time or Part time, Number)*

Indicator 1.7 Existence of communication strategies and feedback mechanism to increase awareness about SFM vis-à-vis woodfuel production and trade

- *Regular meetings among line agencies, LGUs, stakeholders*
- *Existence of multi-sectoral community organizations*
- *Various fora*
- *Various forms of interactions and feedback mechanisms*

Indicator 1.8 Existence of and ability to apply, appropriate technology to practice sustainable woodfuel production and efficient utilization and marketing of woodfuel products especially charcoal and fuelwood.

- *Description of technologies used to enhance woodfuel production (particularly charcoal) and the effects of using such technology*
- *Description of any recent changes in the technology used*
- *Description of what improvements are proposed*
- *Description of what constraints are present upon introducing the improvement*

Indicator 1.9 Capacity and mechanisms for planning sustainable woodfuel management and production systems and for periodic monitoring, evaluation and feedback on progress and status

- *Description of mechanisms used for planning SFM vis-à-vis woodfuel production including periodic monitoring, evaluation and feedback on progress*
- *Description of the capacity available and institutions responsible for these purposes*
- *A list of major constraints encountered in planning*

Indicator 1.10 Public participation in forest management planning relative to woodfuel production and management systems in terms of decision making, data collection, monitoring and assessment.

- *A list of institutions responsible for these processes*
- *Description of the processes of public participation, indicating the parties involved and their level of involvement*
- *Improvements proposed and constraints met during the interventions*

Indicator 1.11: Existence of forest management plans vis-à-vis Woodfuel Management and Production Plans

- *Number of management plans (i.e. in terms of hectares or area)*

- *Description of effectiveness of FMP and woodfuel management and production plans*
- *Improvements proposed and constraints in their introduction*

PRINCIPLE 2: **Woodfuels resource-base needs to be secure**

A sustainable woodfuel production and management system relative to SFM is a long-term enterprise and depends critically upon the stability of a nation's forest estate. Therefore, this criterion is founded on the basic premise that in order to achieve sustainable woodfuel production and management goals, there should be protection of forest and or woodfuel resources. It considers the extent and percentage of land under natural and planted forests, the needs for the conservation of biological diversity through the maintenance of a range of forest types and the integrity and condition of forest resources. There has to be a description of the resource base. An updated, overall land-use plan is important to ensure sustainable woodfuel production and management, relative to the other sectors of the economy. In this context, the external boundaries of the permanent forest estate should be clearly demarcated and changes in their extent should be regularly monitored.

CRITERION 2: Extent and condition of woodfuels resource-base security

Indicator 2.1 Extent in terms of area and the percentage of total land area under comprehensive land-use plans

Indicator 2.2 Extent of forests committed to production of woodfuels and protection against illegal use.

Indicator 2.3 Extent in terms of area and percentage of total land area under each forest type allocated to woodfuel production and trade

- *Description of forest type and classification used relative to SWP*
- *Classification of forest type based on species composition and so on relative to SWP*

Indicator 2.4 Percentage of Permanent Forest Estate with boundaries physically demarcated relative to woodfuel production and trade (and protected areas).

Indicator 2.5 Changes in Forested Area

- *Area at last reporting*
- *Areas formally converted to agriculture*
- *Areas converted to settlements, infrastructure development*
- *Areas converted to other purposes*
- *Areas formally added*
- *Areas converted illegally*

Indicator 2.6 Forest Condition relative to woodfuel production

- *Area of primary allotted to woodfuel production*
- *Managed primary forest vs. WP*
- *Area degraded primary forest vs. WP*
- *Area of secondary forest vs. WP*
- *Area of degraded forest lands vs. WP*

PRINCIPLE 3: There is a healthy biological functioning of forest ecosystem vis-à-vis sustainable woodfuel sources of supply

This principle relates to the healthy biological functioning of forest ecosystems as the proper environment for sustainable woodfuel sources of supply. This can be affected by a variety of human actions such as encroachment, illegal harvesting, human induced fire and pollution, grazing, mining, poaching and many others.

CRITERION 3: Ecological condition of the origin of supply of woodfuels

Indicator 3.1 The extent and nature of forest encroachment, degradation, and disturbance caused by humans that jeopardize sustainable woodfuel production and the control procedures applied (in this case woodfuel plantations and or similar set-ups).

- *List of five major activities*
- *A list of institutions responsible for implementing control procedures*
- *List of constraints in implementing control procedures and any proposed improvements*

Indicator 3.2 The extent and nature of forest degradation and disturbance due to natural causes that jeopardize sustainable woodfuel production and the control procedures applied.

- *List of five major activities*
- *A list of institutions responsible for implementing control procedures*
- *List of constraints in implementing control procedures and any proposed improvements*

PRINCIPLE 4: There is a sound and viable woodfuel production and woodfuel flow system

This principle is concerned with forest management for the production of wood and non-wood forest products transformed into fuelwood and charcoal. Such production can only be sustained in the long term if it is economically and financially viable, environmentally sound and socially acceptable. Trees earmarked for fuelwood and charcoal purposes are able to fulfil a number of other important functions such as environmental protection, carbon storage and the conservation of species and ecosystems. These multiple roles of forest and trees should be safeguarded by the application of sound management practices that maintain the potential of the forest resource to yield the full range of benefits of society.

CRITERION 4: Woodfuel production and woodfuel flows

Indicator 4.1 Extent and percentage of trees for which inventory and survey procedures have been used to define the quantity intended for woodfuel production.

- *Exclusivity of rights and ownership over the area should be clarified/defined properly;*
- *Public reservation areas includes military reservations*
- *Other tenure arrangements such as TLA, IFMA, SIFMA, CBFM and others are under the state ownership*
- *Source of forest products is either natural forest or plantation forest*
- *Sources of information need to include date of inventory*

Indicator 4.2 Actual and sustainable harvest of wood for fuelwood and charcoal purposes

- *Type of forest product*
- *Units of measurement*
- *Volume by source (annual, total and average figures)*

Indicator 4.3 Composition of harvest

- *The most important species or species of groups harvested*
- *Average harvesting quantity (Permanent Forest Estate vs. Non-PFE) over the last 3-year period together with the source of data and the unit of measurement*

Indicator 4.4 Estimate of carbon stored in forests (Wood Plantations)

- *Description of methods of measurement; express in tones of elemental carbon*
- *Reference year*
- *Above ground carbon stock*
- *Soil carbon stock*

Indicator 4.5 Existence and implementation of woodfuel harvesting/operational plans (within woodfuel management plans) and other harvesting permits (small, medium and large scale permits without woodfuel management plans).

- *Description the procedures and processes for formulating plans and assessing of effectiveness of implementation of woodfuel harvesting/ operational plans*
- *Any other type of harvesting/ cutting permits within and outside PFE*

Indicator 4.6 Extent of compartments/ coupes harvested according to harvesting/ operational plans and any other harvesting/ cutting permits

- *Calculate average over most recent 3-year period*
- *Specify the different types of permits and report on their effects on woodfuel production sustainability*

Indicator 4.7 Existence of woodfuels e.g. charcoal and fuelwood tracking system of similar control mechanisms

- *Description of type of systems and its implementation*
- *Description of responsible parties*

Indicator 4.8 Long term projections, strategies and plans for woodfuel production

- *Description of projections, five years and beyond, or plans for production to bring current management of harvesting practices and patterns into alignment with sustainable woodfuel production and management*

Indicator 4.9 Availability of historical records on the extent, nature and management of woodfuel

- *Are historical records available about the extent, nature and management of woodfuels?*
- *Are there descriptions of the types of records?*

- *Do archives of woodfuel data, e.g. yield, uses, etc, exist and are they accessible for planning and management?*
- *Have such records been used?*
- *Have these records been proven useful in the past?*

Indicator 4.10 Availability of silvicultural procedures for timber and NWFP

- *Does the country have recommended silvicultural systems?*
- *What are they?*
- *Are they effectively monitored?*
- *At what geographical scale?*
- *Describe post-harvesting surveys to assess the effectiveness of the silvicultural activities*
- *Are monitoring data being archived to evaluate cumulative effects of silvicultural systems over time?*
- *Do silvicultural systems include the use of chemicals?*
- *If yes, specify and assess risks.*

PRINCIPLE 5: Ecosystem diversity and conservation can be accomplished if the establishment of a sound woodfuel production and management system co-existing with the establishment and management of protected areas through effective land-use policies and systems.

CRITERION 5: Biological diversity

This criterion relates to the conservation and maintenance of biological diversity, including ecosystems, species and genetic diversity. The general principles and definitions used here are those established by CBD and IUCN. The conservation of ecosystem diversity can best be accomplished by the establishment and management of a system of protected areas (combinations of IUCN Categories I and IV) containing representative samples of all forest types linked as far as possible by biological corridors or "stepping stones" relative to woodfuel production and management systems. This can be ensured by effective land-use policies and systems for choosing, establishing and maintaining the integrity of protected areas in consultation with and through the involvement of local communities.

Indicator 5.1 Protected areas containing forests with woodfuel plantations and or woodfuel production

- *Type of protection forest*
- *Location with FMU (extent/area of woodfuel production)*
- *Percentage of each forest type covered*
- *Percentage of boundaries or clearly defined*

Indicator 5.2 Protected areas connected by biological corridors or stepping stones

Indicator 5.3 Existence and implementation of procedures to identify and protect endangered, rare and threatened species of forest flora and fauna

- *Description of procedures to identify, list and protect endangered, rare and threatened species of forest flora and fauna vis-à-vis woodfuel production system*
- *List of institutions responsible*
- *Description of any recent change in the procedures*
- *Constraints in introducing improvements*

Indicator 5.4 Number of endangered, rare and threatened forest-dependent species

- *List of trees, flowering plants, ferns, birds, fresh water fish, amphibians, mammals, butterflies, others*

Indicator 5.5 Measures for in situ and or ex situ conservation of the generic variation within commercial, endangered, rare and threatened species of forest flora and fauna

- *Description of the measures applied to conserve genetic diversity*
- *Institutions responsible*
- *Description of recent changes*
- *Proposed improvements*
- *Possible constraints*

Indicator 5.6 Existence and implementation of procedures for protection and monitoring of biodiversity in production forests relative to woodfuel production in terms of:

- *Retaining undisturbed areas*
- *Protecting rare, threatened and endangered species*
- *Protecting features of special biological interest*
- *Assessing recent changes*
- *Description of any procedures being implemented*
- *Is the effectiveness being monitored?*
- *At what geographical scale?*
- *Description of procedures for assessing changes in production areas compared to control areas*
- *Are records kept over time?*

Indicator 5.7 Extent and percentage of production forest which has been set aside biodiversity conservation.

- *Area and percentage*

PRINCIPLE 6: Woodfuel production systems need to be sensitive to the requirements of soil and water protection in order to achieve a sustainably managed forest systems.

CRITERION 6: Soil and water protection in relation to woodfuel production

The importance of this criterion is two-fold. First, it has a bearing on maintaining the productivity and quality of soil and water within the forest and its related aquatic ecosystems (and therefore on the health and condition of the forest. Second, it also plays a crucial role outside the forest in maintaining downstream water quality and flow and in reducing flooding and sedimentation. Quantitative indicators of the effects of forest management on soil and water are therefore such measures as soil productivity within the forest and data on water quality and average and peak water flows for streams emerging from the forest. This information is difficult and expensive to obtain and is seldom available for more than a limited number of sites, as each site has its own characteristics in this respect (for example, slope, geological structure and the inherent erodibility of the soil type). The protection of soil and water is therefore best ensured by specific guidelines for different situations; these can only be based on experience and research.

Indicator 6.1 Extent and percentage of total forest area managed exclusively for the protection of soil and water and where woodfuel production is being managed sustainably.

- *Are there procedures to assure protection of downstream catchment values?*
- *Are they being implemented?*
- *Is their effectiveness being monitored?*
- *What are the geographical locations?*

Indicator 6.2 Procedures to protect soil productivity and water retention capacity within the production forest vis-à-vis woodfuel production units

- *Are there procedures to protect soil productivity and retain water within production forest in general and woodfuel production sites in particular?*
- *Are there provisions to prevent contamination of forest soil and water relative to woodfuel production areas?*
- *Are they being implemented?*
- *Is their effectiveness being monitored?*
- *At which geographical locations and scale?*

Indicator 6.3 Procedures for forest engineering includes several requirements

- *What are the drainage requirements?*
- *Conservation of buffer strips along streams and rivers.*
- *Protection of soils from compaction by harvesting machinery.*
- *Protection of soil from erosion during woodfuel harvesting operations.*
- *Are there recommended forest engineering procedures (woodfuel areas) in regard to the protection of soil and water?*
- *Are they implemented?*
- *Is their effectiveness being monitored?*
- *What geographical areas and scale?*

Indicator 6.4 Extent and percentage of areas of protected forest estates production which has been defined as environmentally sensitive (very steep or erodible) relative to woodfuel areas.

- *Which areas are defined as ecologically vulnerable hence woodfuel production is not recommended?*
- *What are the area characteristics?*
- *What is the area in hectare terms?*

PRINCIPLE 7: The economic, social and cultural characteristics of an area need to be respected and minimally disturbed since a sustainably managed forest and sustainably managed woodfuel production system has the potential to make a valuable contribution to the overall sustainable development of a country.

CRITERION 7: Economic, social and cultural aspects

This criterion deals with the economic, social and cultural aspects of the forest in general and woodfuel production in particular. A well-managed forest and well-managed woodfuel production system is a constantly self-renewing resource and it produces a host of benefits, ranging from high quality timber, fuelwood, and charcoal and this satisfies the basic needs of people living in and around the forest. It also contributes to the well-being and enhances the quality of life of the population in providing opportunities for recreation and ecotourism as well as providing livelihood and employment opportunities in fuelwood and charcoal production, trading and distribution. Likewise, in the case of fuelwood and charcoal, these resources form part of Filipino culture in terms of culinary preferences. If sustainably maintained, a sustainable woodfuel production system will also provide sustainable economic opportunities for communities.

Indicator 7.1 Value and percentage contribution of the woodfuel sector to GDP

- *Reference year*
- *GDP amount*
- *Description of the extent of the informal sector of woodfuel industry contributes to GDP*
- *Sources of data*

Indicator 7.2 Value of domestically-produced fuelwood and charcoal

- *Domestic market*
- *Export market*
- *Informal markets including marginal and illegal activities*
- *Annually/ seasonally*

Indicator 7.3 Woodfuel production capacities

- *Volume of woodfuel products processed*
- *Volume of woodfuel products produced*
- *Efficiency of the woodfuel industry*

Indicator 7.4 Existence of the implementation of mechanisms for the equitable sharing of woodfuel management costs and benefits

- *List mechanisms for the distribution of incentives*
- *Fair sharing of costs and benefits among parties*
- *Are they implemented?*
- *Are there obstacles?*
- *Are there improvements?*

Indicator 7.5 Number of people depending upon woodfuel production for their livelihoods

- *Number employed in formal woodfuel operations*
- *Number obtaining livelihood in informal woodfuel operations*
- *Other indirect employment*
- *Other subsistence activities*

Indicator 7.6 Training, capacity-building and manpower development programs for forest workers

- *Indicate the number and main focus of universities, technical institutions with formal SFM with SWP*
- *List short and medium term training programs for woodfuel managers for the last year*

Indicator 7.7 Existence and implementation of procedures to ensure the health and safety of woodfuel production workers

- *What mechanisms are in place for the health and safety of woodfuel workers?*
- *Are the mechanisms being implemented?*
- *What are the constraints?*
- *What is the number of serious accidents over the last 3 years?*
- *What are their causes?*

Indicator 7.8 Area of forest upon which people are dependent for woodfuel production either for subsistence uses, traditional and customary lifestyles

- *Specify types of forests used for woodfuel production either for subsistence, traditional or customary lifestyles*

Indicator 7.9 Number and extent of woodfuel sites available primarily for research and education

- *Number of sites*
- *Area in hectare*
- *Average number of users on an annual basis*

Indicator 7.10 Number of cultural factors leading to the use of woodfuels

- *Culinary practices requiring the use of woodfuels*
- *Seasonality of practices*
- *Use of multiple fuels*
- *Reasons for preference in woodfuels*
- *Fuel-switching incidence*
- *Patterns and trends*
- *What tenure rights are practiced?*
- *How is this practiced?*
- *What are the descriptions of constraints and proposals for improvements?*

Indicator 7.11 Extent of involvement of indigenous people, local communities and other forest dwellers in woodfuel management capacity building, consultation processes, decision making and implementation

- *Description of involvement from LGUs, NGOs, other community-based groups*
- *Frequency of regular meetings*
- *Documents to support level of interactions*
- *Community dynamics*
- *Local laws and ordinances*
- *Legal basis for this involvements*
- *Shortcomings and proposals for improvements*

CONCLUSIONS AND RECOMMENDATIONS

The study would like to close by reviewing and listing down the salient findings for policy consideration (Final Report DAP: Policies and Strategies toward Sustainable Development of Fuelwood Sector):

On fuelwood and charcoal:

a) Low-income households are the main users of fuelwood and charcoal.

b) Majority of households are dependent on fuelwood and charcoal as principal energy source or as secondary household energy source.
c) There are many industries as well who depend upon woodfuels as alternative source of energy.
d) Fuelwood and charcoal remain to be major alternative to imported energy.
e) Fuelwood and charcoal trading are important sources of income for many rural as well as urban households.
f) Fuelwood is generally gathered for free from local environment, particularly in the rural areas. Fuelwood is traditionally a free resource and generally gathered at no monetary cost. In the rural areas approximately 70 percent of the total households collect fuelwood for free.
g) Resistance to the adoption of improved cook stove technology is highly probable. Since fuelwood is gathered for free, users are not receptive to shifting towards the use of efficient and improved cookstoves.
h) The bulk of primary fuelwood supply is sourced from Alienable and Disposable private lands. Past studies reveal that 70 percent of the fuelwood users gather their supply from locations less than one kilometre from their residences. This suggests that a major portion of fuelwood supplies, particularly in the rural areas are sourced from A and D lands and some also from nearby public lands, mainly secondary forests and some protected areas.
i) There are no clear policies linking woodfuel requirements with the management and development of energy resources.
j) The national energy plans do not take into account the contribution of woodfuels to the country's energy economy.
k) There is no specific entity that is directly responsible for supervising and coordinating woodfuel related programs and projects.
l) There is a dearth of information and data base on supply and demand of indigenous energy resources particularly those on fuelwood and charcoal.
m) Aggregate demand and supply figures are irrelevant due to location specific situations, spatial distribution of supply and demand and the economic cost and benefits of transportation.
n) Fuelwood and charcoal sector policies must therefore recognize and build upon location specific characteristics e.g. spatial variation to woodfuel sector policies.
o) Provinces most likely to encounter problems over the short to medium-term are Category I, II, III provinces.
p) Probable over-exploitation of primary fuelwood resources due to preference for fuelwood over other biomass resources.
q) Many provinces have abundant primary and secondary fuelwood resources which are under-utilized.
r) Many rural areas possess surplus secondary biomass materials much of which remains underutilized.
s) There seems to be no constraint as far as the availability of commercial-ready biomass conversion technologies.
t) User conversion technologies which are currently used are inefficient.

u) Although there are a number of improved technologies for charcoal production, most of the charcoal is produced in underground pits or above ground mounds whose yields are very low. Unless conversion technologies are further improved, strategies to promote continued production and use of charcoal as a biomass fuel may lead to greater depletion of fuelwood resources. In this regard, there is a need to review present policies and programs on charcoal production.

v) User technologies are dictated by cost.

In conclusion, fuelwood and charcoal are important residential and commercial fuels. Most of the fuelwood comes from lands that are non-forest classification and most of the time fuelwood is gathered for free. Charcoal is an important fuel due to cultural preferences for certain types of food. Charcoal production technologies continue to be traditional and inefficient.

The Philippine C&I apply to all forest conservation and forest products that include NWFPs. The Philippine Forestry Sector is currently working out guidelines and schemes to implement such Criteria and Indicator system for Forest Certification. Accordingly in terms of products produced, whatever applies to the National, also applies to Forest Management Unit and Small forest management units. Woodfuel production usually takes place within small forest management units and also small farm management units. Therefore, criteria and indicators that apply to forest lands and affect woodfuel production is part of the certification of woodfuels only when the production take place in "forest" or public lands. Otherwise, there needs to be another set of criteria and indicators that include agricultural and non-forest lands where fuelwood is gathered and charcoal is produced.

It is important to note in conclusion six indicators that continue to be fall short of compliance within the framework of Philippine Criteria and Indicator System. In most cases, the indicators apply only at the National Level but not at the Forest Management Unit Levels (Philippine C&I Framework, 2007). These are:

1. Existence and implementation of policies, laws and regulations to govern forest management (only at the National level, FMU not yet).
2. The structure and staffing of institutions responsible for sustainable forest management (only at the National level, FMU not yet).
3. Protected areas connected by biological corridors or stepping stones (National level, FMU not yet).
4. Existence and implementation of procedures to identify and protect endangered, rare and threatened species of forest flora and fauna (only National level, FMU not yet).
5. Extent and percentage of total forest area managed exclusively for the protection of soil and water (only National level, FMU level not yet).
6. Value and percentage contribution of the forestry sector to the Gross Domestic Product (National level already considered, FMU level not yet).

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8. The analysis of sustainable fuelwood production systems in Tanzania

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EXECUTIVE SUMMARY

According to UBET (Unified Energy Terminology) woodfuels include all types of biofuels derived directly and indirectly from trees and shrubs grown in forests and non forest land. Woodfuels can be divided into four main types of products: charcoal, fuelwood, black liquor and other. Fuelwood is not therefore synonymous with woodfuel as often regarded. Woodfuel constitutes a major source of energy in most countries, both developing and developed. In most cases methods used to extract wood energy are not sustainable, leading to land degradation. This report reviews the status of fuelwood in Tanzania and the potential for sustainable production through certification. In the text, fuelwood is used in the same context as firewood. It should be noted that accurate figures on woodfuel consumption are not readily available. The estimates given in this text are mainly based on literature that could be accessed.

In Tanzania 88 per cent of the total energy consumption is estimated to be fuelwood and 4 per cent charcoal, leaving only 7 per cent for petroleum and 1 per cent for electricity from hydropower. Major fuelwood consumers are household domestic purposes, and small-scale industries related to agriculture such as tobacco and tea curing, brick burning fish smocking, etc. Fuelwood constitutes 96.6% and 4.2%, of cooking and lighting fuel respectively in rural areas in Tanzania. The per capita consumption seems to be dropping from an average of 2 in the 1960s to a range of 1.0–1.5, suggesting improved utilization efficiency. Given that 75% of the Tanzanian population (34 443 603) lives in the rural areas, the domestic fuelwood requirement is more than 25 832 702 m^3year^{-1}.

Tobacco is a major cash crop for export in Tanzania. It is produced in Iringa, Tabora, Ruvuma and Mbeya. It is estimated that to cure a hectare of tobacco requires approximately one hectare of woodland. The magnitude of deforestation caused by unsustainable fuelwood consumption for tobacco curing and brick burning is estimated at around 20 000 ha per annum, the former contributing the most.

Tea is cultivated in most highlands of Tanzania. This includes East and West Usambara in Tanga region, Mbeya and Iringa regions. All these industries use fuelwood for curing tea. Few industries such as the Ubena Tea Company in Njombe grow their own tree plantations while others such as Wakulima Tea Company in Tukuyu outsource wood from individual tree growers. It takes 1 m^3 or 0.65 tons of dry wood to cure 350 kg of tea. Wakulima Company has the capacity to produce up to 3 985 tons of tea per year while Ubena produces 3 500 tons per year. Thus the annual fuelwood requirement for the two companies is 22 000 m^3

Other rural fuelwood consuming industries include fish smoking beer brewing, bread making, salt drying, brick making, lime making. Although these industries are known to consume significant volume of wood, there are hardly any reliable rates of consumption and impact on the environment. It is however known that all sites in Tanzania where fish smoking is practiced are facing fuelwood scarcity.

The major source of fuelwood is the natural forests, plantations and trees outside the forests. It is believed that subsistence fuelwood collection rarely affects the natural miombo woodlands since only the dead wood or wood cut for other purposes is collected. As such in most cases the impact of fuelwood consumption for domestic purposes has little impact to deforestation. Clearing for agriculture, grazing and harvesting of fuelwood from miombo woodlands for tobacco and tea curing, fish smoking, bear brewing, bread baking, salt-drying and brick and lime making without planting trees are the main agents contributing to deforestation.

The potential for woodland to produce fuelwood mainly hinges on the ability of the woody species to regenerate and grow. Harvested miombo woodlands for woodfuel production would normally regenerate by coppicing and recruitment from stunted saplings. Because of regeneration in areas previously cut and if there is no further disturbance, such areas usually revert to woodland, thus increasing the potential of the area to supply fuelwood over a much longer time period.

The stand density of woody plants in dry forests varies widely. For instance, in miombo woodland the stand density of woody species mostly ranges between 380 and 1 400 stems. In most miombo stands, the basal areas range from 7 to 25 m^2 per ha. The mean harvestable volumes in miombo range between 14 m^3 and 117 m^3 per ha depending on rainfall. The mean annual volume increment (MAI) in mature miombo woodland ranges from 0.58 to 3 $m^3 ha^{-1} yr^{-1}$.

The total forest plantation area in Tanzania is about 100 000 ha. Most of these are for timber and pulp production. In most of these plantations fuelwood collection of dead branches is done free of charge by women in the surrounding villages. During harvesting the non merchantable (crooked, deformed and smaller ends of the stem) are staked and sold as fuelwood to urban customers for use in bakeries and few households. This is especially so for forest plantations in close proximity to urban centres such as Meru forest project in Arusha. The quantity of fuelwood from the forest plantations is yet to be established.

Few plantations are established purely for the production of fuelwood wood. These include forest plantations established for wood production for curing tea. The Ruvu Fuelwood Pilot Project is a recent initiative to establish forest plantations for commercial fuelwood production. It is not clear whether the end product will be fire wood, charcoal, or both. The Tanganyika Wattle Company (TANWAT) is currently producing wood volumes in excess of 60 000 tones per annum which is used to generate 2.5 mega watts of power connected to national grid system. The company also supplies woodfuel to Kibena Tea Limited, Njombe. These are only a few of the forest plantations that are supplying woodfuel, indicating their tremendous potential if sustainably managed.

There is hardly any data on how much fuelwood is collected from agroforestry home gardens in Tanzania. Observations in Coast region however indicates that farm land trees, mainly old cashew nut mango and occasionally jack fruit trees are also used for fuelwood and charcoal production.

Use of energy saving appliances and practices aim at minimizing consumption and hence achieving sustainable production. Other advantages of energy saving kilns and stoves include providing time for women for other development activities, promoting the utilization of local resources and enhancing environmental sanitation by utilizing waste products such as sawdust and rice husks whose disposal is sometimes a problem. Significant efforts have been made in Tanzania to improve the thermal efficiency from 7–12 of the traditionally used three stone fuelwood stoves to about 20% of the brick or metal stoves designed by several NGOs such as SCAPA (Soil Conservation and Agroforestry Project, Arumeru, CAMATEC (Centre for Agriculture Mechanization and Rural Technology, Arusha), SECAP (Soil Erosion Control and Agroforestry Program Lushoto), TaTEDO (Tanzania Traditional Energy Development Organization, Dar se Salaam) and the Traditional Irrigation and Environmental Development Organization, Moshi. It is not by coincidence that most of these NGOs are Agroforestry/Environment related but rather to emphasize that the primary objective of introducing energy efficient stoves is to save the environment. Adoption of these stoves however is generally low due to lack of skills and technical assistance on how to construct them.

Though its direct cost is negligible, since it is not in most cases traded in the market, the economic and social cost of burning fuelwood is immense. Mostly these costs come in the form of opportunity costs which are not easily quantified by economic statistics – poor health, lost time and human effort expended. In areas with fuelwood scarcity, women and children spend hours each day in the drudgery of collecting fuelwood. Because children are involved in acquiring fuelwood, this means they spend less time, or no time, in school. The time that rural women spend collecting fuelwood and performing other household tasks (which are also largely based on manual labour) leaves little time for productive employment, education and community involvement. For tobacco curing most of the fuelwood is obtained free and its cost is often ignored or omitted in production and processing plans.

In strictly ownership terms, land in Tanzania may be regarded as: general land - administered by the commissioners of lands, reserved land - under statutory or other bodies and village land - administered by the village council. Fuelwood may be extracted from all the three categories of ownership. This is in contrast to charcoal which mostly comes from the general land. Collection of dry fuelwood is allowed even in strictly protected areas such as the Amani Nature Reserve after paying a small fee. The Forest Act states that licences for fuelwood will be issued either by quantity or by time such that: quantity licences are charged at TAS 3 000 per m^3 and time licence whereby the licensee is charged TAS 1 000/= to enter the forest reserve and remove one head load (28 kgs) of dead fallen wood daily for a calendar month. Nothing is mentioned on fees from the general or village land. Fuelwood is therefore regarded as a free commodity. It may therefore be concluded that with the exception of fuelwood production for agricultural industries the influence of land tenure on the availability of fuelwood is small.

Several sectors have reviewed their policies as a response to the Poverty Reduction Strategy Paper popularly known as *Mkukuta* in Kiswahili in Tanzania. Sectors that are related to wood energy include forestry, energy, agriculture and livestock, environment, wildlife, fishery, science and technology, women and gender development. Some of these have been discussed in relation to wood energy.

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Certification provides assurance that people who live in or close to the forest must benefit from its management and use. Forest certification therefore is a process that leads to the issue of a certificate by an independent party, which verifies that an area of forest is managed to a defined standard.

Relevance of certification of woodfuel in Tanzania is based on the fact that current woodfuel production practices are not sustainable. Woodfuel extraction is the principle factor responsible for deforestation in Tropical countries including Tanzania.

Criteria and indicators are tools which will help guide national policies, regulations and legislation and which will guide monitoring and reporting on status and overall trends in forest management. Desirable developments will be demonstrated by positive aggregate trends in the identified indicators. Based on information on the trends at national level, and on forecasts for the future based on these, policy and decision making can be rationalized and action can be adjusted and improved. Seven common thematic areas of sustainable forest management have emerged based on the regional and international criteria and indicators initiatives. These are: extent of forest resources, biological diversity, forest health and vitality, productive functions and forest resources, protective functions of forest resources, socioeconomic functions, legal, policy and institutional framework.

Although not much explicitly for fuelwood production, the thematic areas have been used in setting the criteria and indicators for charcoal certification in Tanzania, with additions to encompass charcoal from plantations and natural forests.

The following constraints are foreseen in implementing woodfuel certification in Tanzania: lack of proper management plans, insecure land tenure, lack of local certifying agencies, uncertainty of the market for certified woodfuel and lack of awareness among stakeholders.

Policy options necessary to support certified woodfuel production should involve: allowing time for markets to develop for certified products so that risks to investors are reduced, building on local market conditions and opportunities, providing adequate time and space for the development of appropriate local institutions, developing effective partnerships for training, technical assistance, processing and marketing appropriate to local goals and including feedback mechanisms for mutual learning so that local knowledge and wisdom can also inform international trade institutions so they can be more responsive to equity and sustainability issues.

In the light of these strategies the following research areas are proposed: development of standards for woodfuel forests management in Tanzania, development of participatory forest assessment techniques in order to capacitate different forestry practitioners and provide them well appropriate monitoring tools, applied research on efficient woodfuel production, processing (packaging, labelling and branding) and marketing, applied research on efficient woodfuel storage and use, applied research on development of appropriate local institutions to support the certification process and applied research on the development of market for certified wood.

It is concluded that the concept of certification is new to Tanzania. Certified woodfuel is obviously going to be expensive. The question is whether people are willing to buy the clean woodfuel at the new price. This is a research area to be pursued. Research is also needed to take stock of all woodfuels using industries and their views on certification. Otherwise mandatory certification would be possible if it were a government policy to reinforce the existing policy for sustainable forest management. In this case awareness raising and sensitization to all stakeholders especially policy makers is necessary.

INTRODUCTION

According to UBET (Unified Energy Terminology) woodfuels include all types of biofuels derived directly and indirectly from trees and shrubs grown in forests and non forest land (FAO, 2004). Woodfuels can be divided into four main types of products: charcoal, fuelwood, black liquor and other. Fuelwood is not therefore synonymous with woodfuel as often regarded (Johnsen, 1999). Woodfuel constitutes a major source of energy in most countries, both developing and developed and its contribution is expected to grow in the future as a result of the application of stricter environmental regulations and the use of more competitive sources of locally-available energy. In most cases methods used to extract wood energy are not sustainable, leading to land degradation. Wood energy production has therefore direct consequences on the environment. Other entities that affect production and availability of wood energy are socioeconomic, cultural, institutional and legal aspects.

In Tanzania, around 91% of all energy consumed is woodfuel (CHAPOSA, 2002), miombo woodland being the source of 60–70% of the annual consumption (Monela *et al*., 1993). It accounts for 97.6% of the total wood products consumed in the country (MNRT, 2001). The estimated national annual woodfuel consumption in Tanzania is 44.8 million m^3 (Kaale, 2005). The major consumer centres (Table 1) are households for cooking (95.4%), rural industries (2.8%) and agriculture (1.4%). The rural industries and agriculture use exclusively fuelwood. On the other hand, the rural households use almost fuelwood exclusively while in urban areas charcoal is used.

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Under certification people who live in or close to the forest must benefit from its management and use.

Under proper forest certification schemes, independent auditors issue a certificate to the forest manager after the quality of forest management has been assessed using nationally agreed standards that meet internationally agreed principles. Once a certificate is given, the auditor makes annual follow-up visits to ensure that the forest continues to be managed to the agreed standard. This report reviews the status of fuelwood in Tanzania and the potential for sustainable production through certification. In the text fuelwood is used in the same context as firewood. It should be noted that accurate figures on woodfuel consumption are not readily available. The estimates given in this text are mainly based on literature that could be accessed.

CURRENT FUELWOOD CONSUMPTION IN TANZANIA

In Tanzania, 88 per cent of the total energy consumption is estimated to be fuelwood and 4 per cent charcoal, leaving only 7 per cent for petroleum and 1 per cent for electricity from hydropower (Mnzava, 1990). Surprisingly, the overwhelming importance of fuelwood has not always been well understood (Johnsen, 1999).

Household and domestic purposes

Fuelwood constitutes 96.6% and 4.2% of cooking and lighting fuel respectively in rural areas (Kaale, 2005) in Tanzania. Subsistence fuelwood consumption in the miombo woodlands surrounding Kitulanghalo Forest Reserve in eastern Tanzania is 1.5 $m^3 capita^{-1} year^{-1}$ (Luoga *et al*., 2000). Other estimates from sites with a range of climatic conditions and ecosystems showed that the consumption ranges from 1 to 3 $m^3 capita^{-1} year^{-1}$ depending on availability, suggesting that people adjust their consumption patterns in response to availability (Johnsen, 1999). Fuelwood scarcity can therefore be viewed as site specific. The per capita consumption seem to be dropping from an average of 2 in the 1960s to a range of 1.0–1.5 (MNRT 2001), suggesting improved utilization efficiency (Kaale, 2005). Given that 75% of the Tanzanian population (34 443 603) (URT 2003) lives in the rural areas the domestic fuelwood requirement is more than 25 832 702 $m^3 year^{-1}$.

Agriculture and small-scale industries

Tobacco Curing

Tobacco is a major cash crop for export in Tanzania. It is produced in Iringa, Tabora, Ruvuma and Mbeya. Mnzava (1981) estimated that to cure a hectare of tobacco requires approximately one hectare of woodland. Similar ratio of 1:1 was also reported by Temu (1979) and Kaaya (1881). It is also estimated that it takes 42 m^3 of wood to cure 1 ton of tobacco (Kaale 2005). These estimates are realistic because the volume of wood in miombo woodlands in Tanzania ranges from 35–70 $m^3 ha^{-1}$ (Malimbwi and Mugasha 2001: Kaale 2005). According to Mangora (2002), ninety percent of households in Urambo District (Tanzania) rely on agriculture for income whereby 75% are regular tobacco growers.

Kaale (2005) reported that in Tanzania, the magnitude of deforestation caused by unsustainable fuelwood consumption for tobacco curing and brick burning is estimated at around 20 000 ha per annum, the former contributing the most. This estimate may be on the lower side because according to Mangora (2002) for Urambo district alone on average, a farmer cultivates 1.3 ha of tobacco each growing season and an estimated 42 738 ha of land is annually cleared for tobacco cultivation. Apart from the area cleared for cultivation, another 42 738 ha of more woodland are also cleared annually for tobacco curing. Under this pace of deforestation, the miombo woodlands in the district cannot sustain the high demands for the tobacco industry. Shifting cultivation, being the major farming system provides a fallow period of an average of 4 years and can therefore no longer sustain the tobacco industry since new land must be opened before returning to the original land after the fallow period. In Iringa region, Tanzania, Abdallah (2006) reported an annual deforestation rate of 319 ha between 1959–1978 and 26.6 ha for the period 1978–1999 attributed to tobacco curing and shifting cultivation. He concluded that for the small scale flue cured Virginia tobacco growing in miombo woodlands would not be viable under current practices.

Table 1. Main consumers of woodfuel, estimated quantities consumed and sources

Consumers	Estimated firewood Consumption m^3 in 2003	Main sources of firewood and other biomass fuels to the consumers							Economics	
		Farmland	Unreserved Forests	Forest Reserves	Game Reserves	Forest industries residues	Agriculture residues	Cow dung	Free collection	Purchased
Households for cooking										
a). In rural areas as firewood	25,000,000	****	***	*		*	**	*	****	*
b). In urban areas as charcoal	17,800,000	*	****	***		**			****	**
Sub total	**42,800,000**									
Rural Industries										
Brick burning	344,000	*	****	**			*		**	****
Fish smoking	425,000		****	**			*		****	**
Bread baking	150,000		****	*					****	**
Salt production	350,000		****	*					****	**
Lime production	4,400		****							
Pottery	20,000	*	****	*		*	*	*	****	**
Processing beeswax	1,000		****	**	*				****	
Beer brewing	No data	**	****							
Smithery (use charcoal)	No data		****	*					**	****
Subtotal	**1,294,400**									
Agriculture										
Tobacco curing	630,000	**	****	***	*				****	
Tea Drying	108,000	****	***			*			****	
Sub total	738,000									
TOTAL	**44,832,400**									****

*Source: MNRT 2001, Kaale 2005 (****Main source – preference number one; ***Secondary source – preference number two bases on accessibility; **Complimentary source based on availability; *Use rarely depending on availability or scarcity of fuelwood)*

Tea Curing

Tea is cultivated in most highlands of Tanzania. These include East and West Usambara in Tanga region, Mbeya and Iringa regions. All these industries use fuelwood for curing tea. Few industries such as the Ubena Tea Company in Njombe grow their own tree plantations while others such as Wakulima Tea Company in Tukuyu outsource wood from individual tree growers. It takes 1 m^3 or 0.65 tons of dry wood to cure 350 kg of tea. Wakulima Company has the capacity to produce up to 3 985 tons per year while Ubena produces 3 500 tons per year. The total annual fuelwood requirement for the two companies is 22 000 m^3. Estimates from other companies are necessary to obtain the accurate fuelwood consumption for tea curing.

Fish Smoking

Tanzania has an annual fishing potential of more than 700 000 tons. Due to poor infrastructure in terms of roads, lack of appropriate processing and refrigeration facilities transportation of fresh fish is difficult, often causing a post harvest loss of about 30% of total catch (Kaale 2005). The remaining option of preservation in the rural areas is fish smoking. Fish smoking is usually a household enterprise whereby most of the fuelwood used is obtained free of charge (Mnzava 1981). There are no proper surveys on the amount of fuelwood consumed in fish smoking but it is estimated that about 1 m^3 of wood is enough to smoke 1 ton of fish. It is also known that all sites in Tanzania where fish smoking is practised are facing fuelwood scarcity. A viable solution would be to establish woodlots for fish smoking and introduce efficient fish smoking kilns.

Other Small Industries

Other small-scale industries that use woodfuel are beer brewing, bread making, salt drying, brick making and lime making. Although these industries are known to consume significant volume of wood, there are hardly any reliable rates of consumption and impact on the environment.

FUELWOOD SUPPLY POTENTIAL

The forests

Natural forests

Subsistence fuelwood collection rarely affects the natural miombo woodlands structure (Chidumayo, 1997). Only the dead wood or wood cut for other purposes is collected. As such in most cases the impact of fuelwood consumption for domestic purposes has little impact to deforestation. Main reasons include: most of the fuelwood used for domestic purposes is collected from farm land trees or shrub land close to consumers within a walking distance of about 500 m (Bandeira *et al.,* 1994); women and children who are the main collectors of fuelwood do not possess appropriate tools for cutting big trees that could contribute to deforestation (Figure 1). In Tanzania, however, there are reported incidences where fuelwood is transported over some 55 km on average from a point of production to a point of consumption (Boberg, 1993). Also cutting of live trees for fuelwood in miombo that has been associated with the emergence and growth of urban fuelwood markets affects the structure of woodlands locally (Chidumayo, 1997). Peri-urban deforestation is the main result of fuelwood consumption in the urban areas

(Chambwera, 2004). Hosier *et al.* (1990) compared four different regionalized fuelwood balances for Tanzania. Out of Tanzania's 20 regions, the number of regions that faced a fuelwood deficit varied from 6 to 15 within the four studies. However, the total fuelwood balance for the country was positive (i.e. increment larger than consumption) in two of the studies and negative in the two others.

Regional woodfuel supply situation was analysed and grouped into three categories namely regions with no reports on woodfuel scarcity, regions with moderate woodfuel supply and regions with reported woodfuel scarcity (Kaale, 2005).

Category One – regions with satisfactory biomass fuels supply. Eight regions are included in this category namely: Coast, Kigoma, Lindi, Morogoro, Mtwara, Rukwa, Ruvuma and Tanga. These regions have forest area of more than 1 ha per inhabitant

Category Two – regions with moderate biomass fuels supply. Six regions are included in this category namely: Arusha[6], Dodoma, Iringa, Mbeya, Singida and Tabora. On average the regions forest area per person ranges between 0.5 ha to 1.0 ha

Category Three – regions with reported severe biomass fuels scarcity. Six regions are in included in this category namely: Dar es Salaam, Kagera, Kilimanjaro, Mara, Mwanza and Shinyanga. Average forest area per person in these regions is below 0.5 ha.

The above categories are broad regional wood biomass fuels situation. At lower levels isolated site-specific biomass fuels scarcities or satisfactory supply can exist.

Deforestation rates (annually) differ among countries: Tanzania (0.3%), Zimbabwe (0.4%), Zambia (0.2%), Botswana (0.1%), Mozambique (0.8%), Malawi (3.3%) and Angola (0.2%) (Chambwera, 2004).

Clearing for agriculture, grazing and harvesting of fuelwood from miombo woodlands for tobacco and tea curing, fish smoking, bear brewing, bread baking, salt-drying and brick and lime making without planting trees are the main agents contributing to deforestation. In the absence of these agents it can generally be concluded that domestic fuelwood consumption in the rural areas has little effect on deforestation.

Woodland Regeneration

The potential for woodland to produce fuelwood mainly hinges on the ability of the woody species to regenerate and grow. Woodland regeneration generally involves seed production, seedling development and vegetative regeneration. In the absence of intense disturbance such as frequent late fires and overgrazing, the dominant trend in regenerating woodland is towards the recovery to original state. For example, if a woodland stand cleared for charcoal production is abandoned to regenerate, it will re-grow virtually unchanged in species composition following clearing. Unless the trees have been thoroughly uprooted, most of the subsequent development of woodland will derive from re-growth of coppice from the surviving stems, stump/root sucker shoots and recruitment from old stunted seedlings already present in the grass layer at the time of tree cut, fall or death (Chidumayo, 1993). Thus, one year after clearing a miombo woodland stand, the sapling population in re-growth may consist of one third coppiced stumps and two thirds seedlings recruited from the stunted seedling pool

[6] Arusha region in this report includes Manyara region.

(Chidumayo, 1997). Frost (1996) recognized four phases in regenerating woodland: (1) initial re-growth, just after sprouting and coppicing (most woody plants in the initial re-growth phase are less than 1 m tall), (2) dense coppice, some two to five years after clear felling, (3) tall sapling phase, starting from six to eight years after regeneration and (4) mature woodland.

Figure 1. Fuelwood collection in Miombo woodlands

Source: Udzungwa National Park Office (2006)

Most seedlings and other tree regeneration (e.g. suckers and coppices) experience a prolonged period of successive annual die back during their development phase. Their success to attain the canopy generally depends on their ability to survive fires and to exhibit rapid growth in years without grass fires (Kielland-Lund, 1982). In general, fire and water-stress during the dry season are responsible for the annual shoot die-backs (Ernst, 1988). This is probably why seedlings in miombo woodlands grow very slowly in height as they initially allocate more biomass to root growth. The under ground parts of seedlings of many miombo trees grow faster than shoots during the establishment period (Chidumayo, 1993). Lees (1962) observed that a comparison of growth rings of root stocks and the established shoots revealed that at least eight years may be needed for miombo woodland seedlings to reach the sapling phase.

After removal or death of the above ground parts of the trees, most woodland stumps produce many sucker shoots. However, during the establishment period the number of shoots would decrease as a result of inter-shoot competition and only dominant shoots contribute to the next generation of re-growth woodland. Sucker shoots grow relatively faster than shoots of stunted old seedlings. This is because stumps retain their well-developed root systems after tree cutting. However, stem height growth in re-growth woodland declines after 5–6 years and remains extremely slow thereafter (Chidumayo, 1993, 1997).

Woodland Productivity

The stand density of woody plants in dry forests varies widely. For instance, in miombo woodland the stand density of woody species mostly ranges between 380 and 1 400 stems per ha (Malaisse, 1978; Nduwamungu and Malimbwi, 1997; Nduwamungu, 2001). In most miombo stands, the basal areas range from 7 to 25 m^2 per ha (Lowore *et al.*, 1994; Nduwamungu, 2001; Malimbwi and Mugasha 2001). Both stand basal area and mean biomass increase with increasing rainfall of a site (Frost, 1996). Stand basal area is linearly related to both harvestable volume and aboveground woody biomass. The mean harvestable volumes in miombo range between 14 m^3 per ha in dry miombo of Malawi (Lowore *et al.,* 1994) and 117 m^3 per ha in Zambian wet miombo (Chidumayo, 1988). In Eastern Tanzania, the volume of harvestable trees for fuelwood in miombo woodland is 35 m^3ha^{-1} (Malimbwi *et al,* 2005). Average aboveground biomass in old growth miombo woodland varies mostly from around 30 tons per ha to about 140 tons per ha (Malaisse, 1978; Malimbwi *et al.*., 1994) generally depending on the amount of annual rainfall and edaphic properties.

The annual increment of girth varies widely depending on species and site conditions. In area protected from fire and human disturbance, the mean growth in girth range from 0.27 cm/year (Grundy, 1995) to 2.2 cm/year (Chidumayo, 1988). The mean annual volume increment (MAI) in mature miombo woodland ranges from 0.58 to 3 $m^3ha^{-1}yr^{-1}$ (Zahabu, 2001; CHAPOSA, 2002). As for the biomass the mean annual increment of biomass in coppice woodland range from 1.2 to 3.4 tons ha-1yr-1, which is about 4-7% of above ground biomass (Chidumayo, 1993). In mature woodlands, the mean annual biomass increment is estimated at 2–3% of the standing stock (CHAPOSA, 2002).

Plantations

The total forest plantation area in Tanzania is about 100 000 ha. Most of these are for timber and pulp production. In most of these plantations fuelwood collection of dead branches is done free of charge by women in the surrounding villages. During harvesting the non-merchantable (crooked, deformed and smaller ends of the stem) are staked and sold as fuelwood to urban customers for use in bakeries and few households. This is especially so for forest plantations in close proximity to urban centres such as Meru forest project in Arusha. The quantity of fuelwood from the forest plantations is yet to be established.

Few plantations are established purely for the production of fuelwood. These include forest plantations established for wood production for curing tea. The Ruvu Fuelwood Pilot Project is a recent initiative to establish forest plantations for commercial fuelwood production. It is not clear whether the end product will be fuelwood, charcoal, or both. The Tanganyika Wattle Company (TANWAT) is currently producing wood volumes in excess of 60 000 tons per annum which is used to generate 2.5 mega watts of power connected to national grid system. The company also supplies woodfuel to Kibena Tea Limited, Njombe. These are only a few of the forest plantations that are supplying woodfuel, indicating their tremendous potential if sustainably managed.

Trees outside the forests

There is hardly any data on how much fuelwood is collected from agroforestry home gardens in Tanzania. Observations in Coast region however indicates that farm land trees, mainly old cashew nut mango and occasionally jack fruit trees are also used for fuelwood and charcoal production (IUCN 2000 in Kaale, 2005). A biomass survey carried out in Zanzibar in 1996 showed that out of the 10.3 million m^3 of wood volume estimated in the islands 40.8% (4.2 million m^3) were coconut trees, 7.5% were cloves, 6.8% were mango trees (Ali *et al.,* 1999). These wood sources are used as fuelwood in most occasions. The forest policy (MNRT 1998) recognizes trees on farmland as the major sources of fuel wood for rural house holds.

Industrial wood waste as source of energy

In most wood-using industries the common wood by-products that may be used as source of energy are sawdust, deformed stems and slabs. Although there are wood industries in Tanzania only few of them utilize wood waste as a source of energy. These include the TANWAT (Tanganyika Wattle Company), Southern Paper Mill, Sao Hill Saw Mill, Tembo Chip Board, and Fibre Board 2000 which burn the waste to provide the power for boilers.

At the TANWAT for example the forest estate comprises 8 000 hectares of wattle trees, 4 000 hectares of pine and 1 000 hectares of eucalyptus. The wattle bark is rich in tannin. The bark is separated from the wood in the field and transported to the factory for processing and manufacture of wattle extract. The wood, which is effectively a waste product, is transported to the power station for use as fuelwood for boilers. At the current wattle extract production levels, wood volumes in excess of 60 000 tons are available per annum. Once the tannin has been boiled out, the (waste) bark provides a further fuel source for the boilers. At current production levels, 10 000 tons of spent bark is available per annum. The eucalyptus in the forest is available in a range of species, some of which are not suitable for conversion into poles. Planting of these species has been discontinued but there is a residual 60 000 tons available in the forest (TaTEDO, 2004).The sawmill produces 3 000 tons sawn timber per annum at a recovery rate of 40% from the pine trees. As such, 4 500 tons of pine waste is produced per annum, comprising off-cuts and sawdust.

In Kilimanjaro region the use of sawdust in brick burning, briquetting and domestic cooking has triggered the demand for sawdust to the extent that there is hardly any sawdust being left in Sawmills (James Sige[7] 2007, personal communication)

ENERGY SAVING APPLIANCES AND PRACTICES

The advantages of energy saving kilns and stoves are:

- minimized consumption of woodfuel,
- provide time for women for other development activities,
- promotion of the utilization of local resources and
- enhanced environmental sanitation by utilizing waste products such as sawdust and rice husks whose disposal is sometimes a problem.

[7] James Sige is the Principal of Tanzania Forestry Industries Training Institute (FITI), Moshi.

Improvement of fuelwood stoves

Significant efforts have been made in Tanzania to improve the thermal efficiency from 7–12 of the traditionally used three stone fuelwood stoves to about 20% of the brick or metal stoves designed by several NGOs such as SCAPA (Soil Conservation and Agroforestry Project, Arumeru, CAMATEC (Centre for Agriculture Mechanization and Rural Technology, Arusha), SECAP (Soil Erosion Control and Agroforestry Program Lushoto), TaTEDO (Tanzania Traditional Energy Development Organization, Dar se Salaam) and the Traditional Irrigation and Environmental Development Organization, Moshi. It is not by coincidence that most of these NGOs are Agroforestry/Environment related but rather to emphasize that the primary objective of introducing energy efficient stoves is to save the environment (TaTEDO 1998, MEM 2003).

Adoption of these stoves however is generally low due to lack of skills and technical assistance on how to construct them (Kaale, 2005). Shortage of extension services on construction and use of efficient fuelwood stoves have been identified as the main causes hindering wide adoption of improved fuelwood stoves in rural areas (MEM 2003). Under the SECAP and SCAPA programs it is common to see village representatives from other districts being trained by farmers under the program on Agriculture and Environmental Conservation issues including improved fuelwood stoves (TARP II, 2004). This is an effective way of technology dissemination as the newly trained farmers become trainers when they return to their villages. Funding the initial training however may be a constraint.

Improvement of kitchen management to save energy

At the household level adoption of improved kitchen management skills is also essential in reducing fuelwood consumption (Kaale, 2005). Such skills include:

- use of dry fuelwood to increase burning efficiency,
- extinguishing fuelwood after cooking,
- pre-treatment of some food stuffs through soaking to reduce cooking time and
- construction of cooking shelters instead of cooking in the open to increase fuelwood utilization efficiency.

SOCIOCULTURAL AND ECONOMIC ASPECTS OF FUELWOOD

Cost of fuelwood

Though its direct cost is negligible, since it is not in most cases traded in the market, the economic and social cost of burning fuelwood is immense. Mostly these costs come in the form of opportunity costs which are not easily quantified by economic statistics – poor health, lost time and human effort expended. In areas with fuelwood scarcity, women and children spend hours each day in the drudgery of collecting fuelwood. Because children are involved in acquiring fuelwood, this means they spend less time, or no time, in school. The time that rural women spend collecting firewood and performing other household tasks (which are also largely based on manual labour) leaves little time for productive employment, education and community involvement.

In urban areas of Kenya, it is the lowest income households who depend on fuelwood the most. Fuelwood is obtained mainly from agroforestry or on-farm sources (84%), from trust lands (8%) and from gazetted forests (8%). Approximately 76% of households obtain all their fuelwood free, 17% of households regularly purchase it while 7% supplement their free collection by purchasing some fuelwood. Fuelwood is mainly used for cooking and space heating (Daniel, undated). For tobacco curing most of the fuelwood is obtained free and its cost is often ignored or omitted in production and processing plans.

HIV/AIDS and woodfuel

HIV/AIDS are a national and global catastrophe. About 15 per cent of Tanzanians are infected with HIV and AIDS and prevention awareness of the disease is low. Youth are highly vulnerable, with about 60 per cent of new infections in Tanzania occur among those aged 15 to 24 (Thomas, 2007). This is the productive working age which is crippled. The main social and cultural impacts of HIV are: high death rates of the working groups and lowering life expectancy. These have consequences on: reduction in productivity, loss of manpower that has been trained at high investment, increased number of orphans, increased child mortality as well as growing number of orphans (Kaale, 2005). Cross cutting issues of HIV/AIDS and woodfuel supply include:

- loss of income for households which depend on sales of woodfuel,
- raised demand for woodfuel for cooking during funeral ceremonies and
- reduction of growth in GDP and reduction in productivity is eroding consumers ability to switch upwards to advanced energy alternatives which would conserve the environment.

LEGAL ASPECTS AND POLICIES INFLUENCING FIREWOOD SUPPLY AND USE

Land and tree tenure systems in Tanzania

During the colonial period, indigenous peoples' rights to harvest and dispose of trees were significantly restricted. Similarly, after independence, Forest Policies in many developing countries have been characterized by the strong concentration of power over forest resources in the central state apparatus, and the corresponding lack of local participation in forest and tree management. Failure to recognize indigenous systems of forest management and indigenous rights to resources at policy level has led to:

- loss of incentives by the local communities to protect trees-hence indiscriminate tree felling,
- discouragement of local people to engage in tree planting and reforestation projects and
- excessive reliance by the state on punitive measures to enforce the law.

The present land tenure system in Tanzania for example, provides four main possibilities of acquiring land for one’s use as specified in the Land Act 1999 (MLHSD,1999b) as follows:

- government leasehold (33, 66 and 99 years renewable),
- right of occupancy (statutory or deemed),
- customary land tenure and
- village land ownership.

In strictly ownership terms, land in Tanzania may be regarded as:

- general land - administered by the commissioners of lands;
- reserved land - under statutory or other bodies
- village land - administered by the village council.

Despite that the new Land Law in Tanzania recognizes the existence of customary rights of rural communities' ownership still remains strictly under the state. The government as the land owner has the power to revoke customary land rights, creating levels of land insecurity. Insecurity of tenure among others has promoted open access to forests and woodlands. Tenure determines whether local people are willing to participate in the management and protection of forests in terms of rights, ownership and access. If these are not well defined, effective participation of the local people in the management of the miombo woodlands may hardly be achieved. For the case of Tanzania it is therefore stressed that the current Village Land Act of 1999 (MLHSD, 1999b) be put into action to make people own land and trees growing on the land. Thus, their participation in woodland management in public lands would be under the custodian of the Commissioner for Lands.

Whereas charcoal mostly comes from the general land, fuelwood may be extracted from all the three categories of ownership. Collection of dry fuelwood is allowed even in strictly protected areas such as the Amani Nature Reserve after paying a small fee. The Fourteenth Schedule of the Forest act No 14 (URT 2002) states that licences for fuelwood will be issued either by quantity or by time such that quantity licences are charged at TAS 3000 per m^3 and time licence whereby the licensee is charged TAS 1 000/= to enter the forest reserve and remove one head load (28 kgs) of dead fallen wood daily for a calendar month. Nothing is mentioned on fees from the general or village land. Fuelwood is therefore almost free of charge as pointed out by Mnzava (1981). It may therefore be concluded that with the exception of fuelwood production for agricultural industries the influence of land tenure on the availability of fuelwood is small.

Relevant sector policies related to woodfuel production

Several sectors have reviewed their policies as a response to the Poverty Reduction Strategy Paper popularly known as *Mkukuta* in Kiswahili in Tanzania. Sectors that are related to wood energy include forestry, energy, agriculture and livestock, environment, wildlife, fishery, science and technology, women and gender development.

The Forest Policy

The first Forest Policy of Tanzania was published in 1953 and revised after 45 years in 1998 (URT 1998). Salient features of the current forest policy that did not surface in the old policy include:

- the goal to enhance the contribution of the forest sector for the sustainable development of Tanzania and the conservation and management of present and future generations,
- the recognition of farmland trees as a major source of fuelwood for rural communities,
- singling out deforestation due to charcoal production, agriculture expansion, overgrazing, wildfires and overexploitation of other wood resources as the major problem facing the forest sector. Estimates deforestation rate at 130 000 to 500 000 ha per annum,

- the recognition of government failure to protect forest reserves due to inadequate resources and recommends collaborative management initiatives as possible solution and
- the recognition of the contribution of woodfuel to the energy balance and its dwindling supply consequently encourages tree planting for woodfuel, use of efficient conversion technologies and promotion of affordable energy alternatives as strategies to address the woodfuel crisis.

The Energy Policy

The first National Energy Policy was published in 1992 and revised in 2003 (MEM 2003). The policy has the following salient features.

- The vision of the energy sector is to effectively contribute to the growth of the national economy and hereby improve the standards of living for the entire nation in a sustainable and environmentally sound manner.
- The mission of the energy sector is to create conditions for the provision of safe, reliable, efficient, cost-effective and environmentally appropriate energy services to all sectors on a sustainable basis.
- The policy provides a very comprehensive analysis of the energy supply and demand situation in Tanzania, including woodfuel and other renewable energy sources.
- The policy states that *"Woodfuel for the foreseeable future will remain the main energy source"*. To ensure sustainable supply of biomass fuels, the policy emphasizes that *"Biomass, particularly woodfuel should be conserved through efficient conversion and end use technologies which could be complemented by tree growing at household level and beyond"*.

In view of the above, it can be observed that the policy gives high emphasis on the need to sustain rural energy and in particular woodfuel. It also promotes efficient woodfuel conservation and end use technologies in order to save resources: reduce rate of deforestation and land degradation and minimizing threats on climate change. This feature is also observed in the forest policy. Although a Renewable Energy Fund has been provided for in the Energy policy, it is not yet operational. One of its possible uses could be to meet cost of mainstreaming certification of woodfuel.

The Agriculture Policy

The Agriculture Policy calls for timely delivery and efficient use of energy inputs, including renewable energy sources into agriculture. It emphasizes the need for agricultural sector to collaborate with forestry in environmental conservation programs. It specifically singles out tobacco production as a cause of deforestation and encourages tobacco farmers to plant trees to meet their woodfuel requirement for tobacco curing.

The Agricultural Sector Development Strategy (URT 2001) developed to implement the policy advocates the use of animal manure for biogas production and planting of nitrogen fixing trees in agroforestry systems in order to increase agricultural production and provide fuelwood to rural communities.

WOODFUEL PROJECTS IN TANZANIA

The Ruvu Fuelwood Pilot Project

The Ruvu Fuelwood Pilot Project (RFPP) which started in 2000 is located in North Ruvu Forest Reserve, about 60 km west of Dar es Salaam (URT, 2004). Being a production forest, closer and accessible to Dar es Salaam, North Ruvu Forest Reserve which covers a total 67 000 ha is a victim of severe degradation due to woodfuel exploitation for the urban population. About 80% of Dar es Salaam city population depend on wood fuel as a first choice domestic energy. About 1 900 ha has been provided by the government under special agreement with 670 households which have been allocated 3 ha plots each to be planted with agroforestry tree species which potential as woodfuel. The participating villages are Kongowe Msangani, Mkuza, and Mwendapole. The planted tree species *are Acacia crassicarpa, A mangium, Brachystea kirkii, Khaya anthotheca, casuarinas equisetifolia, Senna seamea, and Eucalyptus terreticornis*. Insitu conservation of *Afzelia quanzensis, Dalbergia melanoxylon, Jurbernardia magnistipula* and *Khaya anthotheca* is also practiced. The average production in farmer managed plots is 6.3m^3/ha/yr compared with 0.96 m^3/ha/yr in non-managed areas. The project has trained farmers on growing woodfuel trees how make charcoal kilns and fuelwood stoves. Between 2000 and 2004 a total of 1 240 000 trees of different species have been planted (Kaale, 2005). The approach is essentially a participatory one. The main goal is to promote sustainable forest resources management through increasing forest regeneration and forest products to meet rural and urban primary energy requirements, while providing realistic economic base for the communities surrounding the forest reserve.

The Maseyu Eco-Charcoal

Maseyu is a village 40 km from Morogoro on the Dar es Salaam highway in an area where the production of charcoal is a major business with a long tradition. The production of Maseyu Eco-Charcoal has two goals: The improvement of the livelihood of the producers of charcoal and the sustainable use of wood as an important natural resource. These two goals are achieved by:

- Tree nursing and woodland management: To ensure sustainable production and source of income, trees are being nursed continuously to replace the wood used for charcoal.
- Efficient production. With improved brick kilns, less wood is needed to produce the same amount of charcoal (3–4 tons of wood per tons of charcoal).
- Marketing: Sustainable Eco-Charcoal will be sold directly to big consumers and in special places (e.g. hotels, supermarkets), assuring a better remuneration of the producers. The intent to help shifting charcoal business from the informal to the formal sector of Tanzania's economy is an important additional goal of this initiative.

Since February 2006, 40 villagers from Maseyu organized in two charcoal groups have nursed 80 000 trees, most of them indigenous Mgunga (*Acacia polyacantha*). Burned bricks have been made locally and the first improved half-orange-shaped kiln was built in which carbonization trials have started in October 2006. The project aims at five charcoal groups operating 5–10 kilns. The eventual goal of the project is to certify the charcoal from this project.

To achieve this, Eco-Charcoal has the following stakeholders. The local stakeholders are the Maseyu village and the Wami-Mbiki Society, a CBO of 24 villages with the goals of sustainable wildlife management and improvement of well-being in its communities, while ESDA (Energy for Sustainable Development Africa) provides the technical backstopping. This pilot is funded by RLDC (Rural Livelihood Development Company) who acts as a facilitator with funds from SDC (Swiss Agency for Development and Cooperation).

TANWAT (Tanganyika Wattle Company)

TANWAT) was founded in 1949, when the Commonwealth Development Corporation (CDC) took responsibility for a forest development project set up two years earlier by the Forest, Land Timber and Railways Company, located in the Southern Highlands of Tanzania with 15 000 hectares of private forest business (TaTEDO, 2004). Production of tannin from wattle was the major source of revenue for the business until late 1960s when a decline in demand for leather goods, brought about by availability of cheaper synthetic alternatives. This resulted in an initiative aimed at exploring new global forestry product opportunities, reducing reliance on tannin products and creating prospects for increased revenue on a long-term basis. The Tanganyika Wattle Company is a fully owned subsidiary of CDC capital fund.

The forest estate comprises 8 000 hectares of wattle trees, 4 000 hectares of pine and 1 000 hectares of eucalyptus. The wattle bark is rich in tannin. The bark is separated from the wood in the field and transported to the factory for processing and manufacture of wattle extract. The wood, which is effectively a waste product, is transported to the power station for use as fuelwood for boilers. At the current wattle extract production levels, wood volumes in excess of 60 000 tons are available per annum. Once the tannin has been boiled out, the (waste) bark provides a further fuel source for the boilers. At current production levels, 10 000 tons of spent bark are available per annum.

The eucalyptus in the forest is available in a range of species, some of which are not suitable for conversion into poles. Planting of these species has been discontinued but there is a residual 60 000 tons available in the forest (TaTEDO, 2004).The sawmill produces 3 000 tons sawn timber per annum at a recovery rate of 40% from the pine trees. As such, 4 500 tons of pine waste are produced per annum, comprising off-cuts and sawdust.

The Tanzania's first commercial wood-fired power plant was commissioned in mid 1995 with an installed capacity of 2.5MW. The plant provides power to the Njombe/TANESCO mini grid. The plant is composed of fuel handling and processing facilities that include a hydraulic feeder or logger, a drum chipper with a capacity of 70m^3 loose chips per hour, chip belt conveyor and two silos, each capable of storing 17 tons of chips. Sustainability of raw material supply is achieved by adhering to the annual planting target of 1 200 ha (900 ha Wattle, 100 ha Eucalyptus and 200 ha Pine). At harvesting the wood productivity is 80T/ha Wattle, 400 m^3ha^{-1} Pine and 300T/ha Eucalyptus (Aza Mbaga 2007, personal communication.[8]) The rotation ages are 10 years for Wattle, 20 years for Pine and 10–12 for Eucalyptus. Kibena Tea Ltd, Njombe (Section 7.5 below) meets her fuelwood requirement for curing tea from TANWAT.

Kibena Tea Limited, Njombe

This company produces tea at the rate of 3 500m tons/yr from a 700 ha farm (Miraji Gembe, 2007, personal communication). The tea is steam cured using fuelwood from

[8] Aza Mbaga is the Chief Forest Manager at TANWAT

Eucalyptus and wattle wood. It takes 1 m^3 or 0.65 tons of dry wood to cure 350 kg of tea. With an annual capacity of producing 3.5 kg of tea the total amount of wood needed annually is 10 000 m^3. Kibena Tea Ltd has contracted TANWAT to produce the required fuelwood and have not faced any problems regarding supply of fuelwood. Assuming productivity of 300 m^3ha^{-1} at harvesting, about 35 ha of plantation needs to be harvested annually.

Wakulima Tea Company Ltd, Tukuyu

This company has the capacity to produce up to 3 985 tons per year. The tea is steam cured using fuelwood from Eucalyptus grown by outgrowers. One m^3 of wood costs TAS 7 000 at the factory as it can cure 332 kg of tea. The annual requirement of wood for tea is therefore 12 000 m^3. The factory prefers mature wood which has high calorific value but since the wood comes from different outgrowers, there is high variation in maturity. Availability of fuelwood during the rain season is also a problem due to poor accessibility and increased distance to the resource. The company is considering producing their own fuelwood and they have set aside 80 ha for planting Eucalyptus. Otherwise future fuelwood supply may not be sustainable.

Other Tea Companies in Tanzania

Other tea companies using woodfuel for curing tea but whose details could not be obtained include Mufindi Tea Company - Mufindi, Herkulu Lushoto, East Usambara Tea Company - Tanga (Amani).

WOODFUEL CERTIFICATION

What is certification?

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Certification provides assurance that people who live in or close to the forest must benefit from its management and use.

Under proper forest certification schemes, independent auditors issue a certificate to the forest manager after the quality of forest management has been assessed using nationally agreed standards that meet internationally agreed principles. Once a certificate is given, the auditor makes annual follow-up visits to ensure that the forest continues to be managed to the agreed standard.

Forest certification therefore is a process that leads to the issue of a certificate by an independent party, which verifies that an area of forest is managed to a defined standard.

Requirements for forest certification

The credibility of certification as key to sustainable forest management hinges on the following requirements:

- The standard has been defined and accepted by stakeholders - local people, forest owners, industry, government, consumers.
- The standard is compatible with globally acceptable principles that balance economic, ecological and social objectives.

- There is independent and credible verification with reporting of results to stakeholders, certification and the market place.
- Certified products can carry a label, which verifies that the timber or wood product originates from well-managed forests.
- Companies in the supply chain hold chain of custody certificates so that the label can follow the wood from the forest to the consumer.

Steps in certification process

Preparing for certification

This involves development of certification standards for sustainable forest management based on Principles and Criteria for the national context by supplementing them with relevant indicators. These national standards provide detailed and specific management requirements. In the absence of nationally adopted certification, standards such as guidance will be provided by the certifiers using generic or local interim standards. The certification standards, though not designed as a forest management manual, provide clear objectives. Certification itself adds the incentive to achieve those objectives.

Also at this stage preliminary visit (scoping visit) is carried out by the certifier. Scoping visits identify major strengths and weaknesses based on a briefing with the managers and/or a rough estimation of the applicant performance. This helps the enterprise

Field assessment

Although certifiers have to remain independent of other interests and therefore are not allowed to provide consultancy services to an operation they certify, in practice the field assessment serves as an informal training opportunity concerning how to reach certification standards. When the assessors interview forest managers and operators about the performance of the operation under investigation the discussions provide a lot of useful hints and recommendations to those involved.

Meeting the condition

The third phase starts when certification has been achieved, but conditionally on certain improvements. The summary of field results provided in the certification report identifies strengths and weaknesses of an operation. It indicates to forest managers what needs to be consolidated and what needs to be improved. It normally contains a list of corrective actions, or conditions, that have to be met within a given time frame. If there are major issues, these have to be met (and will be checked) before a certificate can be granted. Minor issues can be dealt with subsequently. Together with specific recommendations it provides a clear guide to what kind of training or other measure might be needed to address any areas of non-compliance with the standards. The regular (at least annual) monitoring visits by the certifier ensure that the corrective actions are followed up.

Production of certified woodfuel in Tanzania

Relevance of certification of woodfuel in Tanzania

About 80 percent of all wood used in the tropics each year is consumed as fuel, mainly as fuelwood, in the country of origin. Fuelwood is the primary source of energy for hundreds of millions of people who do not have access to fossil fuels, or can not afford them. The remaining 20 per cent of the yearly production of tropical wood is used as industrial timber, of which four-fifths are also consumed in the country of origin (Julio, 1997). Woodfuel extraction is therefore the principle factor responsible for deforestation in Tropical countries including Tanzania.

Tanzania has a total area of about 94.5 million ha out of which 88.6 million ha is covered by landmass and the rest is inland water. Forests cover about 34 million hectares of the total land area. There are 13.9 million hectares of declared forest reserves in a country of which 12.3 million (81.5%) are under central government and the rest under local governments (district/town or city councils) and private ownership. Village Forest Reserves cover about 3 million ha. These are under Collaborative Forests Management (CBFM) an initiative that was introduced in Tanzania in the early 1980s with some experiences of success stories from Nepal and India. The practice is already legitimized by the parliament through the current forest act of 2002. Most of the CBFM forests are demarcated as part of village general land. Thus they are also called village forest reserves. There are more than 9 000 villages in Tanzania but currently CBFM is confined to only a few.

Apart from the aforesaid different forest management regimes in place, current statistics also reveal that the remaining forest area in general land is about 18 million ha. These forests are “open access” characterized with insecure land tenure, shifting cultivation, harvesting for woodfuel, poles and timber and heavy pressure for conversion to other competing land uses, such as agriculture, livestock grazing, settlements, industrial development in addition to wild fires. The rate of deforestation in Tanzania which is estimated at more than 500 000 hectares per annum is mostly impacting such general land forests. On the other hand, reforestation and aforestation activities by private and local communities are also done in general land areas. Therefore there is a room for much more sustainable forest management activities that may alter the observed high rate of deforestation in the country. Forest certification may offer a better control for forest exploitation for both reserved and unreserved forests in the country.

Criteria and indicators of fuelwood certification in Tanzania

Although not much explicitly for fuelwood production, the thematic areas may be used in setting the criteria and indicators for charcoal certification in Tanzania, with additions to encompass charcoal from plantations and natural forests. The proposed C&I for sustainable production of woodfuel in Tanzania are presented as Appendix 1 of this report. The following sources of criteria and indicators were consulted in compiling the criteria and indicators.

- The Analysis of Sustainable Fuelwood and Charcoal Production Systems in Nepal (Bhattarai and Shrestha, 2007)
- The Tarapoto Proposal of Criteria and Indicators for Sustainability of the Amazon Forest (ACT, 1995)
- International Tropical Timber Organization (ITTO) (Anon. 1998 a)
- African Timber Organization (ATO) (Anon, 1998 b)
- The CIFOR Criteria and Indicators Generic Template (CIFOR, 1999)
- Criteria and Indicators for SADC Countries within the Framework of the Dry-Zone Africa Process (Anon, 1999)

Tanzania is a member to the SADC and ATO. Some of the features of these C&I are therefore related to Tanzanian policy. For example the establishment of a Forest Service in charge of the management of all the forests as a necessary indicator in the institutional framework is currently an ongoing process in Tanzania.

The implementation of C&I developed for a particular product and country involves several stakeholders. Similarly rigorous consultations are prerequisite during preparation of C&I. In Malaysia final C&I for woodfuel was compiled by an appointed committee of stakeholders assigned to refine the C&I in addition to identification of activities for each indicator (Tang, 2001). This is a necessary step for the Tanzanian case whereby the current document should form the draft for the final document acceptable to relevant stakeholders.

Constraints for woodfuel certification in Tanzania

Although woodfuel certification is still lacking in Tanzania, the following limitations are foreseen:

<u>Lack of proper management plans</u>

As is the case with most developing countries there is no reliable data on forest extent, characteristics, and growth and yield because national forest inventory is not carried out (FAO, 2006) due to limited capacity in terms of number of staff and finance. This has led to poor forest management because of lack of data for making informed management decisions. The Tanzania forest policy (URT, 1998) and its forest act (URT, 2002) clearly stipulate the need for proper forest management based on specific forest management plans but except for private forests there is hardly a forest reserve with a proper management plan. This could affect the certification process.

<u>Insecure land tenure</u>

Long-term tenure and use rights to the land and forest resources are required for the forest certification. In Tanzania most of the land is under local communities with customary tenure or use right but not formally surveyed and mapped. As such sometimes land may be set aside by the government for other uses including establishment of private forests. When such circumstances happen, disputes of substantial magnitude involving a significant number of interests normally occur. This may affect the certification process unless clear evidence of long-term forestland use rights (e.g. land title, customary rights, or lease agreements) is demonstrated. It is required that local communities with legal or customary tenure or use rights shall maintain control to the extent necessary to protect their rights or resources, over forest operations unless they delegate control with free and informed consent to other agencies.

<u>Lack of local certifying agencies</u>

World-wide certification generally has had support from local and international NGOs, government and bilateral aid organizations. However, in Tanzania currently there are no local supporting organizations for the certification process. Lack of local organizations means additional costs for the certification process, as it has to be carried out by expatriates. The costs of certification include both direct assessment costs as well as indirect costs to improve management practices and to meet certification requirements. Such costs are high and a burden for any small-scale enterprise. In this respect woodland management for fuelwood production will be difficult to cover these costs. This is the case with most community-based forest management projects and small private forestlands. Economies of scale do not favour any of these operations and appropriate solutions will need to be found for each of them.

Equally important at the national level, certification initiatives and associated standard setting processes facilitate a redefinition of roles and responsibilities with regard to forest management. However, there is so far no clearly developed national or regional forest certification systems based on broad stakeholder consensus and acceptance. This to a greater extent will limit certification process in Tanzania.

Uncertainty of the market for certified woodfuel

Experiences with forest certification show that contrary to expectations frequently raised by NGOs and donors, certification has no mechanism to facilitate consistent access to the market potential for certified products (Irvine, 2002). The certification, as it has been structured to date, reinforces an existing trend which is for forestry products to try to enter international markets. This requires the creation of higher order regional processing and marketing structures, as well as closer links with industry. The lack of domestic markets for certified products is especially problematic for forest enterprises. Because certification is at an early stage in its development as a market tool, certified markets still represent a high risk for most forest enterprises. This could be minimized by developing certification trade networks in different parts of the world and retail companies. However large-scale industrial producers are more likely to be able to provide the needed quantities and qualities to out-compete small scale enterprises.

Lack of awareness among stakeholders

Forest certification is still a new concept in Tanzania. As such effort are needed to raise awareness among different stakeholders including foresters, environmental and conservation organizations, loggers, forest dwellers, research and academic institutions, social and human rights advocacy groups, indigenous communities, development and aid organizations, government representatives, timber trade dealers and associations and concerned individuals. It is also important not to forget groups which are often excluded from decision making processes such as under-represented social and ethnic groups, women, youth, rural communities, land owners and foresters.

Policy options necessary to support certified woodfuel production

The local existing markets in Tanzania offer very low value and therefore low prices for fuelwood. This is because wood for fuelwood has been regarded as a free good that requires just the producer effort to extract. To a great extent this situation is brought about by the fact that forests from which the woodfuel is extracted are not managed. Policy interventions to support sustainable forest management of the fuelwood producing woodlands should therefore be developed. This may be built on woodfuel certification, that among other things ensures that fuelwood in the market is produced from sustainably managed forests.

Increasing stakeholders' awareness in participation, and benefits from forestry certification will require strategies that:

- allow time for markets to develop for certified products so that risks to investors are reduced,
- build on local market conditions and opportunities,

- provide adequate time and space for the development of appropriate local institutions,
- develop effective partnerships for training, technical assistance, processing and marketing appropriate to local goals and
- include feedback mechanisms for mutual learning so that local knowledge and wisdom can also inform international trade institutions so they can be more responsive to equity and sustainability issues.

On the light of these strategies the following research areas are proposed:

- development of standards for woodfuel forests management in Tanzania,
- development of participatory forest assessment techniques in order to capacitate different forestry practitioners and provide them will appropriate monitoring tools,
- applied research on efficient woodfuel production, processing (packaging, labelling and branding) and marketing,
- applied research on efficient woodfuel storage and use,
- applied research on development of appropriate local institutions to support the certification process and
- applied research on the development of market for certified wood.

PROPOSED CRITERIA AND INDICATORS OF FUELWOOD CERTIFICATION IN TANZANIA

PRINCIPLE 1: POLICY, PLANNING AND INSTITUTIONAL FRAMEWORK

This principle involves the government commitment to support sustainable forest management in harmony with national and international laws and policies

Criterion 1.1 Government commitment to support sustainable forest management for woodfuel production

Indicators:

- *Appropriate political and legal framework that stimulates sustainable development*
- *Clear and focused policy statements supporting sustainable forest management*
- *Existence of a forestry service in charge of the management of all the forests, with adequate staffing to fulfil its mandate*

Criterion 1.2 Policy formulation and implementation are carried out in a participatory manner.

Indicators:

- *Existence of a mechanism for enhancing participatory policy formulation*
- *Existence of multi-sectoral interactions during policy formulation and implementation*
- *Regularity of meetings, discussions and other forums for which records of minutes of meetings are prepared and made available.*
- *Policy statements in non-forestry sectors (e.g. Agriculture, Energy, Fisheries) that recognizes and supports sustainable forest management for woodfuel production.*

Criterion 1.3 Recognition of international laws and conventions addressing forestry and other environmental issues

Indicators:

- *Capacity to represent the country to international instruments and conventions to which the country is part of (egg ILO, CITES, ITTO, FAO, ATO, UNCED)*
- *Compliance of government circulars and directives to provisions of international laws*

Criterion 1.4 Extent of the forest resource well defined

Indicators:

- *There exists a map showing the boundaries of the forests.*
- *The boundaries of the forests estate are well marked on the field.*
- *Areas and percentages of forest lands and non forest land that produce woodfuel, in relation to total land area are known.*
- *No evidence of forest encroachment*

Criterion 1.5 Effective structure for the promotion of private forestry and trees outside the forests (ToF)

Indicators:

- *Effective institutional support for commercial production of woodfuel from private forestry and TOF*
- *Existence of inter-sectoral coordination between sectors related to forestry*

PRINCIPLE 2: CONSERVATION OF BIODIVERSITY AND MAINTANANCE OF ECOSYSTEM FOR ENVIRONMENTAL PROTECTION ENHANCED

Criterion 2.1 Conservation of biodiversity in natural and planted forests at all tenure levels (egg government forests, private forests, community forests)

Indicators:

- *Diversity of habitat in terms of flora and fauna maintained.*
- *Identification of endangered, rare and threatened species that should be exempted from woodfuel production.*
- *Identification and zonation of biodiversity hotspots of flora and fauna that should be protected from any disturbance.*
- *Species richness maintained.*
- *Other specific management activities in place to conserve biodiversity of special biological interest, such as seed trees, nesting sites, niches and keystone species.*

Criterion 2.2 Ecosystem and protective functions of the forest maintained

Indicators:

- *Special provisions for the protection of sensitive areas, plains, stream banks, steep slopes should be defined.*

- *Erosion and other forms of soil degradation are minimized (sensitive areas identified and appropriate control measures applied).*
- *Soil and water restoration programs are implemented when necessary.*

Criterion 2.3 Forest health and vitality maintained or improved

Forest condition and health can be affected by a variety of human actions and natural occurrences, from air pollution, fire, flooding and storms to insects and disease.

Indicators:

- *Absence of damaging human activities such as: encroachment, agriculture, roads, mining, dams, unplanned fire, nomadic grazing, illegal exploitation, inappropriate harvesting practices, hunting, and other forms of forest damage such as change in hydrological regime, pollution, introduction of harmful exotic plant and animal species.*
- *Degree of forest damage by natural causes: wild fire, drought, storms or natural catastrophes, pests and diseases, and other natural causes*
- *Existence of procedures to prevent/control: fires, diseases and pests.*

PRINCIPLE 3: SOCIO-ECONOMIC FUNCTIONS ARE SUSTAINED

Criterion 3.1 Improved incomes through sustainable production and consumption of woodfuel

Indicators:

- *Employment generation from woodfuel production activities in relation to total national employment.*
- *Average per capita income in different woodfuel production activities.*
- *Efficiency and competitiveness of woodfuel production and processing systems*
- *This includes improved kiln efficiency and minimization of waste through briquetting in charcoal making.*
- *Economic profitability of management of the forests for woodfuel production.*
- *Sustainable production, consumption and extraction of woodfuel.*

Criterion 3.2 Investment and economic growth in the forest sector

Indicators:

- *Annual investment in woodfuel plantations, sustainable forest management and conservation in relation to total forest sector investment.*
- *Aggregate value of sustainable woodfuel production.*
- *Rate of return on investment on sustainable production of woodfuel, compared with rates of return in other sources of energy, considering all costs and benefits.*

Criterion 3.3 Enhanced cultural and social values

Indicators:

- *Level of reduction of drudgery for women and children as a result of sustainable availability of woodfuel*
- *Level of participation of local populations in the management and in the benefits generated by woodfuel production activities.*
- *Absence of activities that compromise human culture*

PRINCIPLE 4: FOREST (WOOD ENERGY) RESOURCE MANAGEMENT INCREASES BENEFITS THROUGH BETTER FOREST MANAGEMENT

Criterion 4.1 Effective local management in place for maintaining and assessing the forest (wood energy) resources.

Indicators:

- *Ownership and use rights to resources are clear and respected.*
- *Rules and norms of resources use are successfully enforced and monitored (existence of rules and norms, patrolling, incidences of violation of rules, number of forest offence cases registered, etc).*
- *Effective and accepted conflict management mechanisms are in place (number of cases resolved).*
- *Access to forest (wood energy) resources is perceived locally to be fair (deprived and poor users get fair concession, access to woodfuel and NTFP, evidence of discussion in meetings on access to resources, attendance of gender, class, and ethnicity in meetings).*
- *Local people feel secure about their access to forest resources, including woodfuels.*

Criterion 4.2 Stakeholders get equitable share from the benefits of forest (wood energy) resource management.

Indicators:

- *Mechanisms for equitable benefit sharing are developed and implemented (local people express satisfaction on the benefits received)*
- *Employment opportunities exist for poor and deprived users (number of such people involved in carpentry works, livestock raring, and fuelwood collection for trade, charcoal making and other income raising activities).*

Criterion 4.3 All production forests under different systems of management be considered as means of livelihood by rural communities

Indicators:

- *The above people invest significant amount of time and efforts in wood energy resource management.*
- *Destruction of natural resources by the local people is rare.*
- *Maximum utilization of the productive national forests (all types) by local forestry stakeholders.*

PRINCIPLE 5: YIELD AND QUALITY OF DESIRED FORESTRY GOODS AND SERVICES ARE SUSTAINABLE

Criterion 5.1 Forest management units are implemented on the basis of legal ownership, scientific forestry practices and recognized traditional rights.

Indicators:

- *Forest management takes place on the basis of inventory information and relevant silvicultural practices.*
- *Information on the identity, location and population of communities living in the vicinity of the managed forests exist*

Criterion 5.2 Management plans are detailed and clearly documented.

Indicators:

- *Management objectives (both long-and short-term) are clearly stated reflecting the condition of forest, expressed public interest of the forestry goods and services, and the local forest users needs.*
- *Harvesting plans are in place taking into consideration available stock and capacity of forest staff to monitor operations.*
- *Forest Working Plan is comprehensive (identifies boundaries, provide inventory of resources, protection, includes management and utilization plans, biodiversity hot spots and cultural and conservation areas).*
- *Appropriate involvement of stakeholders in Management Plan preparation and takes into account all components and functions of the forest (i.e. timber, woodfuel, NTFP etc).*
- *Yield regulation by area and/or volume is prescribed in Forest Harvesting Plan (allowable cuts, minimum exploitable diameter, number of trees or total volume to be harvested per year etc).*
- *Silvicultural systems are prescribed and are appropriate to forest types.*
- *Prescribed harvesting systems and equipment match the condition of forest in order to reduce impact.*
- *Forest Management/Harvesting Plan is periodically revised and approved by the Director of Forestry and Beekeeping*
- *Programs and estimated costs of forest management activities are covered in the Management Plan on a priority basis.*

Criterion 5.3 Effective monitoring system is implemented.

Indicators:

- *Mechanisms for monitoring and evaluation are clearly described in the Forest Working/Operational Plan, including chain of custody monitoring of products.*
- *Documentation and record of all forest management and forest activities are kept in forms that enable monitoring, also for product tracking during transportation and transformation*

Criterion 5.4 Costs and benefits from all types of forests are properly accounted for, distributed and shared among relevant stakeholders

Indicators:

- *Mechanisms for sale and/or equitable distribution of forest products (including woodfuels) to relevant stakeholders are clearly described in the Harvesting Plan*
- *Re-investment of the benefits from forestry management for forestry development.*

Criterion 5.5 Promotion of user and environment friendly wood energy technologies, government initiatives of R & D on woody and non-woody biomass based modern energy applications

Indicators:

- *List of environment friendly modern wood energy technologies relevant to Tanzania.*
- *Priority R & D areas in modern wood energy applications (i.e. technologies and end-uses).*
- *Priority R & D areas in non-wood biomass based modern energy applications (i.e. technologies and end-uses).*

Criterion 5.6 Guidelines for quality control of fuelwood produced

Indicators:

- Species used
- Size of billets
- Moisture content

CONCLUSIONS

The concept of certification is new to Tanzania. There is evidence of only one project, Kilombero Forest Limited which is striving to develop CDM (Clean Development Mechanism) in the year 2000 whereby certification is one of the basic requirements in order to qualify for carbon credits. To date the goal has not been achieved, probably indicating the complexity of the process. Kilombero Forest Limited is not a fuelwood project but a timber project.

Among the woodfuel projects in chapter 7, it is only the Maseyu Eco-Charcoal, which has a clear objective of achieving certification of her future charcoal, but they also face the obvious uncertainty of market. Certified fuelwood is obviously going to be expensive. In Malaysia it is estimated that the initial cost required to improve harvesting for certified timber is US$ 65.05 ha^{-1} which is equivalent to 65% of total harvesting cost without the improvement (Thang, 2001). Other sources of cost will be packaging, labelling and monitoring. The question is whether people are willing to buy the clean fuelwood at the new price. This is a research area to be pursued.

On the other hand, the tea factories obviously have some mechanism of ensuring continued supply of fuelwood but it is not clear whether the systems are sustainable to meet certification requirements. It is also not known whether they would like to use certified woodfuel. Unless there is pressure from above such business enterprises would like to reduce production cost by using easily available and cheap woodfuel. Research is needed to take stock of all such woodfuel using industries and their views on certification. Otherwise mandatory certification would be possible if it were a government policy to reinforce the existing policy for sustainable forest management. In this case awareness raising and sensitization to all stakeholders especially policy makers is necessary.

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9. The analysis of sustainable charcoal production systems in Tanzania

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EXECUTIVE SUMMARY

Charcoal is a woodfuel produced in rural areas and consumed in cities and towns. Some of the factors influencing the choice of using charcoal instead of firewood in urban areas include: Charcoal has a higher calorific value per unit weight that firewood, it is therefore more economic to transport charcoal over longer distances as compared to firewood; Storage of charcoal takes less room as compared to firewood; Charcoal is not liable to deterioration by insects and fungi which attack firewood; Charcoal is almost smokeless and sulphur – free, as such it is ideal fuel for towns and cities. In year 2000, the actual charcoal consumption was estimated in three African cities to about 140,000 tons for Maputo (Mozambique), about 314,000 tons for Dar es Salaam (Tanzania) and about 245,000 tons Lusaka (Zambia).

Some households tend to use certain fuel energy sources for cooking certain foods or for other kind of activity requiring energy such as lighting or heating. As for Dar es Salaam, 69% of the households used charcoal as their first choice fuel for cooking. However, most of the households (88%) combine two or more types of fuels. Major factors influencing choice of fuel or fuel mix are; availability, affordability and reliability. A comparison of fuel preferences between 1991/92 and 2000/01 showed that many households in Dar es Salaam city are shifting from other fuels to charcoal.

Most charcoal produced comes from the woodlands although insignificant amount also comes from plantations and trees outside the forests. The potential for woodland to produce charcoal mainly hinges on the ability of the woody species to regenerate and grow. Miombo woodlands cut for charcoal production would normally regenerate by coppicing and recruitment from stunted saplings. Because of regeneration in areas previously cut, and if there is no further disturbance, such areas usually revert to woodland, thus increasing the potential of the area to supply charcoal over a much longer time period.

The stand density of woody plants in dry forests varies widely. For instance, in miombo woodland the stand density of woody species mostly ranges between 380 and 1400 stems. In most miombo stands, the basal areas range from 7 to 25 m^2 per ha. In Eastern Tanzania, the volume of harvestable trees for charcoal in miombo woodland is 35 m^3ha^{-1}. The mean annual volume increment (MAI) in mature miombo woodland ranges from 0.58 to 3 m^3ha-1yr-1.

Woodland degradation in charcoal producing areas are due to other human disturbances, such as grazing, frequent fires and extended cultivation periods, which may prolong the recovery period. As such charcoal burning contributes to deforestation. Charcoal production has largely been responsible for the degradation of the woodlands and, together with agriculture, for large scale deforestation that has occurred in Southern Africa over time. In Tanzania, for example, charcoal production was responsible for degradation of 29,268 hectares (24.6 %) of closed woodland and deforestation of 23,308 hectares (19.58 %) of closed woodland and 92761 hectares (50.8%) of open woodland in the catchment area to the west and North of Dar es Salaam that supplied charcoal to Dar es Salaam City.

Charcoal production has far reaching socioeconomic dimensions. The economy of people in the charcoal producing areas largely depends on subsistence agriculture. In areas with reasonable accessibility, charcoal is the main cash crop of the rural households. For example

in eastern Tanzania communities adjacent to the Morogoro – Dar es Salaam highway earn about USD 176 to 645. This indicates a growing dependence on charcoal for household income whereby about 75% of farmers in charcoal producing areas had charcoal as an important source of income. The income from the sale of charcoal was also found to be above the minimum wage paid to most of the governments' employees. This has a consequence of attracting more people to engage in charcoal making. Migration to charcoal producing areas is common. In Tanzania 40% of the charcoal makers have no formal education. The activity requires neither formal education nor large capital investment although it is time consuming and labour intensive which is usually drawn from household. Therefore given the low education level required, the income is attractive to other people to join the business, and thus more deforestation to the woodlands.

Charcoal production sites are usually located close to access roads to simplify transportation and sale. Normally, charcoal kilns are located within 5 to 15 km. However, as woodlands deplete on favourable distances or when preferred species are exhausted, charcoal producers move even further and take the burden of carrying charcoal loads to the roadside. From the roadside, several means of transport are used to carry charcoal loads usually in bags weighing around 50 to 60 kg once packed with charcoal. These include open trucks buses and minibuses; bicycles; motorcycles, head loads and other types of vehicles (e.g. tankers and saloon cars). Despite bicycles hauling relatively smaller percentage (< 10%) all of charcoal to the city, they are the most frequent means of transporting charcoal suggesting that most people involved in charcoal business are poor who can not afford to pay for better means of transport, but are engaged in this business just to earn their living.

The profit margin in charcoal transportation and trade is relatively small, particularly for trucks in the dry season, which provide for a strong incentive to evade paying taxes and levies. Evasion is apparently through many means, including night time transportation which is forbidden for biomass resources and various forms of collusion and payments to guards at the check points (Malimbwi *et al*. 2004). In Zambia, it was also found that profits from the charcoal business are marginal both at production and retail stages. Yet, the business continue because of low opportunity costs in rural areas as a result of failure in the agriculture industry and decline in formal employment opportunities in urban areas. In many cases, charcoal production seems to happen out of necessity as a last resort to earn income to the rural households. Thus, lack of alternative income sources is a compelling factor for the decision to engage in charcoal production. Commercial production is only induced from urban centres (CHAPOSA, 2002). Charcoal retailing in many African cities is very well structured so as to make charcoal accessible to different consumers. Charcoal prices do not increase in real terms, even though inflation causes the current prices to increase. In most African cities for at least the last two decades, urban consumers have been paying slightly less than US $ 0.10 per kg of charcoal.

According to the recent regulations for charcoal preparation, transportation and selling of 2006 (URT, 2006) amendments to the Forest Act No. 14 of 2002 (URT 2002), it is required that District harvesting committee be established and charged with the roles to prepare and maintain a register of all charcoal dealers in the district under the custodian of the District Forest Office. The local government in turn, shall, in areas of jurisdiction, set special areas for preparation and selling of charcoal. The rules emphasize that any charcoal prepared, must comply to any fee, levy or charge by the village government, the Committee or any other relevant authority. However, a survey showed that 75% of the 24,000 bags of charcoal consumed daily in Dar es Salaam city are not accounted for at the checkpoints.

Several sectors have reviewed their policies as a response to the Poverty Reduction Strategy Paper popularly known as *Mkukuta* in Kiswahili in Tanzania. Sectors that are related to wood energy include forestry, energy, agriculture and livestock, environment, wildlife, fishery, science and technology, women and gender development. Some of these have been discussed in relation to wood energy.

There are few woodfuel projects established in Tanzania. These include; The Ruvu Fuelwood Pilot Project, The Maseyu Eco-Charcoal, TANWAT (Tanganyika Wattle Company), Kibena Tea Limited, Njombe, Wakulima Tea Company Ltd, Tukuyu However only two are targeted to produce charcoal; The Ruvu Fuelwood Pilot Project and The Maseyu Eco-Charcoal

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Certification provides assurance that people who live in or close to the forest must benefit from its management and use. Forest certification therefore is a process that leads to the issue of a certificate by an independent party, which verifies that an area of forest is managed to a defined standard.

Relevance of certification of woodfuel in Tanzania is based on the fact that current woodfuel production practices are not sustainable. Woodfuel extraction is the principle factor responsible for deforestation in Tropical countries including Tanzania.

Criteria and indicators are tools which will help guide national policies, regulations and legislation, and which will guide monitoring and reporting on status and overall trends in forest management. Desirable developments will be demonstrated by positive aggregate trends in the identified indicators. Based on information on the trends at national level, and on forecasts for the future based on these, policy and decision making can be rationalised and action can be adjusted and improved. Seven common thematic areas of sustainable forest management have emerged based on the regional and international criteria and indicators initiatives. These are: Extent of forest resources; Biological diversity; Forest health and vitality; Productive functions and forest resources; Protective functions of forest resources; Socio-economic functions; Legal, policy and institutional framework.

Although not much explicitly for charcoal production the thematic areas have been used in setting the criteria and indicators for charcoal certification in Tanzania, with additions to encompass charcoal from plantations and natural forests.

The following constrains are foreseen in implementing wood fuel certification in Tanzania: lack of proper management plans insecure land tenure; lack of local certifying agencies; uncertainty of the market for certified woodfuel; lack of awareness among stakeholders. Policy options necessary to support certified wood fuel production should: allow time for markets to develop for certified products so that risks to investors are reduced; build on local market conditions and opportunities; provide adequate time and space for the development of appropriate local institutions; develop effective partnerships for training, technical assistance, processing and marketing appropriate to local goals; include feedback mechanisms for mutual learning so that local knowledge and wisdom can also inform international trade institutions so they can be more responsive to equity and sustainability issues.

In light of these strategies the following research areas are proposed: Development of standards for woodfuel forests management in Tanzania; Development of participatory forest assessment techniques in order to capacitate different forestry practitioners and provide them will appropriate monitoring tools; Applied research on efficient woodfuel production, processing (packaging, labelling and branding) and marketing; Applied research on efficient woodfuel storage and use; Applied research on development of appropriate local institutions to support the certification process; Applied research on the development of market for certified wood.

It is concluded that the concept of certification is new to Tanzania. Certified woodfuel is obviously going to be expensive. The question is whether people are willing to buy the clean woodfuel at the new price. This is a research area to be pursued. Research is also needed to take stock of all woodfuel using industries and their views on certification. Otherwise mandatory certification would be possible if it were a government policy to reinforce the existing policy for sustainable forest management. In this case awareness raising and sensitization to all stakeholders especially policy makers is necessary.

INTRODUCTION

According to UBET (Unified Energy Terminology) woodfuels include all types of biofuels derived directly and indirectly from trees and shrubs grown in forests and non forest land (FAO 2004). Woodfuels can be divided into four main types of products: charcoal, fuelwood, black liquor and other. Fuelwood is not therefore synonymous with woodfuel as often regarded (Johnsen 1999). Woodfuel constitutes a major source of energy in most countries, both developing and developed, and its contribution is expected to grow in the future as a result of the application of stricter environmental regulations and the use of more competitive sources of locally-available energy. In most cases methods used to extract wood energy are not sustainable, leading to land degradation. Wood energy production has therefore direct consequences on the environment. Other entities that affect production and availability of wood energy are socio-economic, cultural, institutional and legal aspects.

In Tanzania, around 91% of all energy consumed is woodfuel (CHAPOSA, 2002), miombo woodland being the source of 60-70% of the annual consumption (Monela *et al*. 1993). It accounts for 97.6% of the total wood products consumed in the country (MNRT, 2001). The estimated national annual woodfuel consumption in Tanzania is 44.8 million m^3 (Kaale, 2005). The major consumer centres (Table 1) are households for cooking (95.4%), rural industries (2.8%) and agriculture (1.4%). The rural industries and agriculture use exclusively firewood. On the other hand the rural households use almost firewood exclusively while in urban areas charcoal is used.

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Under certification people who live in or close to the forest must benefit from its management and use.

Under proper forest certification schemes, independent auditors issue a certificate to the forest manager after the quality of forest management has been assessed using nationally agreed standards that meet internationally agreed principles. Once a certificate is given, the auditor makes annual follow-up visits to ensure that the forest continues to be managed to the agreed standard. This report reviews the status of firewood in Tanzania and the potential for sustainable production through certification. It should be noted that accurate figures on woodfuel consumption are not readily available. The estimates given in this text are mainly based on literature that could be accessed

CURRENT CHARCOAL CONSUMPTION IN TANZANIA

Charcoal is a woodfuel produced in rural areas and consumed in cities and towns. Some of the factors influencing the choice of using charcoal instead of firewood in urban areas include (Kaale 2005):

- Charcoal has a higher calorific value per unit weight that firewood (About 31.8 MJ per kg of completely carbonized charcoal with about 5 percent moisture content as compared to about 16 MJ per kg of firewood with about 15 percent moisture content on dry basis.
- Due to its high calorific value per unit weight, it is more economic to transport charcoal over longer distances as compared to firewood.
- Storage of charcoal takes less room as compared to firewood.
- Charcoal is not liable to deterioration by insects and fungi which attack firewood.
- Charcoal is almost smokeless and sulphur – free, as such it is ideal fuel for towns and cities

In year 2000, the actual charcoal consumption was estimated in three African cities to about 140,000 tons for Maputo (Mozambique), about 314,000 tons for Dar es Salaam (Tanzania) and about 245,000 tons Lusaka (Zambia) (CHAPOSA, 2002).

Some households tend to use certain fuel energy sources for cooking certain foods or for other kind of activity requiring energy such as lighting or heating. CHAPOSA (2002) reported that in Lusaka (Zambia), 65% of the households used charcoal as the only energy source while the rest of the households used charcoal in combination with firewood (23%), kerosene (17%) and electricity (1%). As for Dar es Salaam, 69% of the households used charcoal as their first choice fuel for cooking. However, most of the households (88%) combine two or more types of fuels.

Major factors influencing choice of fuel or fuel mix are; availability, affordability and reliability. A comparison of fuel preferences between 1991/92 and 2000/01 shows that many households in Dar es Salaam city are shifting from other fuels to charcoal (Table 1).

Table 1. Household fuel preferences between 1991/92 and 2000/01

Type of fuel	Percentage preference	
	1991/92*	2000/01
Charcoal	51	69
Kerosene	28	25
Electricity	15	4
Wood	1	1

** Source: CHAPOSA (2002)*

Most city households (88%) combine two or more types of energy sources/fuels. This is partly because they tend to use certain fuel energy sources for certain foods. For example the cooking of dried beans or maize cereals require longer cooking times and in such instances most people resort to using charcoal or firewood instead of electricity. The same households will use kerosene or other more expensive but convenient energy sources such as electricity to cook quick meals or heat pre-cooked food

CHARCOAL SUPPLY POTENTIAL

The natural forests

Most charcoal produced comes from the woodlands (Johnsen, 1999). . It has been estimated that 4354 ha of woodland are cleared per year in order to supply Dar es Salaam with charcoal (Monela *et al.*, 1993). The potential for woodland to produce charcoal mainly hinges on the ability of the woody species to regenerate and grow.

Woodland regeneration

Woodland regeneration generally involves seed production, seedling development and vegetative regeneration. In absence of intense disturbance such as frequent late fires and overgrazing, the dominant trend in regenerating woodland is towards the recovery to original state. For example, if a woodland stand cleared for charcoal production is abandoned to regenerate, it will regrow virtually unchanged in species composition following clearing. Unless the trees have been thoroughly uprooted, most of the subsequent development of woodland will derive from regrowth of coppice from the surviving stems, stump/root sucker shoots and recruitment from old stunted seedlings already present in the grass layer at the time of tree cut, fall or death (Chidumayo, 1993). Thus, one year after clearing a miombo woodland stand, the sapling population in regrowth may consist of one third coppiced stumps and two thirds seedlings recruited from the stunted seedling pool (Chidumayo, 1997). Frost (1996) recognised four phases in regenerating woodland: (i) initial regrowth, just after sprouting and coppicing (most woody plants in the initial regrowth phase are less than 1 m tall), (ii) dense coppice, some two to five years after clear felling, (iii) tall sapling phase, starting from six to eight years after regeneration, and (iv) mature woodland.

Most seedlings and other tree regeneration (e.g. suckers and coppices) experience a prolonged period of successive annual die back during their development phase. Their success to attain the canopy generally depends on their ability to survive fires and to exhibit rapid growth in years without grass fires (Kielland-Lund, 1982). In general, fire and water-stress during the dry season are responsible for the annual shoot die-backs (Ernst, 1988). This is probably why seedlings in miombo woodlands grow very slowly in height as they initially allocate more biomass to root growth. The under ground parts of seedlings of many miombo trees grow faster than shoots during the establishment period (Chidumayo, 1993). Lees (1962) observed that a comparison of growth rings of root stocks and the established shoots revealed that at least eight years may be needed for miombo woodland seedlings to reach the sapling phase.

After removal or death of the above ground parts of the trees, most woodland stumps produce many sucker shoots. However, during the establishment period the number of shoots would decrease as a result of inter-shoot competition and only dominant shoots contribute to the next generation of regrowth woodland. Sucker shoots grow relatively faster than shoots of stunted old seedlings. This is because stumps retain their well-developed root systems after tree cutting. However, stem height growth in regrowth woodland declines after 5-6 years and remains extremely slow thereafter (Chidumayo, 1993, 1997).

Woodland productivity and charcoal yield

The stand density of woody plants in dry forests varies widely. For instance, in miombo woodland the stand density of woody species mostly ranges between 380 and 1400 stems per ha (Malaisse, 1978; Nduwamungu and Malimbwi, 1997; Nduwamungu, 2001). In most miombo stands, the basal areas range from 7 to 25 m^2 per ha (Lowore et al., 1994; Nduwamungu, 2001; Malimbwi and Mugasha 2001). Both stand basal area and mean biomass increase with increasing rainfall of a site (Frost, 1996). Stand basal area is linearly related to both harvestable volume and aboveground woody biomass. The mean harvestable volumes in miombo range between 14 m^3 per ha in dry miombo of Malawi (Lowore et al., 1994) and 117 m^3 per ha in Zambian wet miombo (Chidumayo, 1988). In Eastern Tanzania, the volume of harvestable trees for charcoal in miombo woodland is $35m^3ha^{-1}$(Malimbwi *et al* 2005). Average aboveground biomass in old growth miombo woodland varies mostly from around 30 tons per ha to about 140 tons per ha (Malaisse, 1978; Malimbwi et al., 1994) generally depending on the amount of annual rainfall and edaphic properties.

The annual increment of girth varies widely depending on species and site conditions. In area protected from fire and human disturbance, the mean growth in girth range from 0.27 cm/year (Grundy, 1995) to 2.2 cm/year (Chidumayo, 1988). The mean annual volume increment (MAI) in mature miombo woodland ranges from 0.58 to 3 m3ha-1yr-1 (Zahabu, 2001; CHAPOSA, 2002). As for the biomass the mean annual increment of biomass in coppice woodland range from 1.2 to 3.4 tons ha-1yr-1, which is about 4-7% of above ground biomass (Chidumayo, 1993). In mature woodlands, the mean annual biomass increment is estimated at 2-3% of the standing stock (CHAPOSA, 2002). In 2002, about 17.84 million m^3 of wood were used for charcoal production in Tanzania. It is estimated that clearing of one hectare of Miombo woodland provides on average $35m^3$ of firewood for charcoal production. Based on this figure, an equivalent of 509,714 hectares, of woodland could have been cleared in 2002 to provide wood for charcoal production (Kaale, 2005).

Fate of current and previous charcoal production areas

In most cases, charcoal producers are not planting trees to replace those cut from miombo woodlands for charcoal burning hence contributing to deforestation at the magnitude of over 400,000 ha per year. Charcoal production has largely been responsible for the degradation of the woodlands and, together with agriculture, for large scale deforestation that has occurred in Southern Africa over time (CHAPOSA 2002; Malimbwi et al., 2001, Dewees, 1994). In Tanzania, for example, charcoal production was responsible for degradation of 29,268 hectares (24.6 %) of closed woodland and deforestation of 23,308 hectares (19.58 %) of closed woodland and 92761 hectares (50.8%) of open woodland in the catchment area to the west and North of Dar es Salaam that supplied charcoal to Dar es Salaam City (CHAPOSA, 2002). It will be noted that where there is bushland, most of it is regenerating from coppice, indicating that trees had been cut most probably for charcoal production. The development trend for the woodlands shows that if no management measures or interventions are put in place, the remaining woodlands in the Dar es Salaam study area will be down to 40% of the present in 2015.

A number of factors, however, play an important role in influencing the trend of miombo woodland development in the current and previous charcoal production areas. Miombo woodlands cut for charcoal production would normally regenerate by coppicing and recruitment from stunted saplings. Because of regeneration in areas previously cut, and if there is no further disturbance, such areas may revert to woodland, thus increasing the potential of the area to supply charcoal over a much longer time period. According to Hosier (1993) woodland appears to recover relatively well following harvesting for charcoal production and in the absence of other human disturbances, such as grazing, frequent fires and extended cultivation periods, which may prolong the recovery period.

This was observed in Tanzania where regeneration was taking place in areas where trees were previously cut for charcoal production with no subsequent cultivation (CHAPOSA, 2002). Typical of such areas are the areas around Mboga and between Lugoba and Msata in Coast region, Tanzania, which are characterized by regenerating Combretum bushland. These areas are believed to have had trees in 1970s-80s but were clear-felled for charcoal production. The re-growth was cut again for charcoal in 1990s. Apparently, most of the areas where trees were cut have not been converted to cultivation; instead they were left to regenerate.

Plantations

The total forest plantation area in Tanzania is about 100,000 ha, most of these are for timber and pulp production. In most of these plantations firewood collection of dead branches is done free of charge by women in the surrounding villages. During harvesting the non merchantable (crooked, deformed and smaller ends of the stem) are staked and sold as firewood to urban customers for use in bakeries and few households. This is especially so for forest plantations in close proximity to urban centres such as Meru forest project in Arusha. The quantity of firewood from the forest plantations is yet to be established.

Few plantations in Tanzania are established purely fore the production of woodfuel (See Chapter 7), but these are mostly targeted to produce fuelwood. These include forest plantations established for wood production for curing tea. The Tanganyika Wattle Company (TANWAT) is currently producing wood volumes in excess of 60,000 tonnes per annum which is used to generate 2.5 mega watts of power connected to national grid system. The company also supplies woodfuel to Kibena Tea Limited, Njombe. These are only a few of the forest plantations that are supplying woodfuel, indicating their tremendous potential if sustainably managed. The Ruvu Fuelwood Pilot Project and the Maseyu Eco-charcoal are probably the only recent initiatives to establish forest plantations for commercial charcoal production.

Trees outside the forests

There is hardly any data on how much firewood is collected from agroforestry home gardens in Tanzania. Observations in Coast region however indicates that farm land trees, mainly old cashew nut, mango and occasionally jack fruit trees are also used for charcoal production (IUCN 2000 in Kaale, 2005). Based on the limited experience from the Coast region, it is assumed that around 10% of the charcoal produced in Tanzania is coming from farm land trees. The amount of woodlands cleared for charcoal production in 2002 could therefore be reduced by 10% (50,971 ha). Theoretical net forest area cleared for charcoal production is therefore estimated at 458,743 ha for year 2002 alone.

A biomass survey carried out in Zanzibar in 1996 showed that out of the 10.3 million m^3 of wood volume estimated in the islands 40.8% (4.2 million m^3) were coconut trees, 7.5% were cloves, 6.8% were mango trees (Ali *et al* 1999). These wood sources are used as firewood in most occasions. The forest policy (URT, 1998) recognizes trees on farmland as the major sources of fuel wood for rural house holds.

ENERGY SAVING APPLIANCES AND PRACTICES

The advantages of energy saving kilns and stoves are:

- Minimize consumption of woodfuel
- Provide time for women for other development activities
- Promotion of the utilization of local resources
- Enhancing environmental sanitation by utilizing waste products such as sawdust and rice husks whose disposal is sometimes a problem

Improvement of charcoal stoves

Most of the NGOs making improved firewood stoves also do make improved charcoal stoves. The thermal efficiency of commonly used metal charcoal stoves in Tanzania is reported to range between 12-15% (MEM 1998) compared to 25% of improved ceramic charcoal. Adoption is however low. Reasons for the slow adoption rates include the higher initial costs (investments) of shifting from standard (less efficient) stoves to the improved types characterized with fragility and shorter lifespan. According to Kaale (2005) ceramic liners are the main component contributing to improvement of energy efficiency of charcoal stoves. However, production of the ceramic stove liners requires suitable clay soil and curing kiln. Without suitable clay soil and proper curing kiln the ceramic liners break easily. Furthermore, the current charcoal price does not exert enough pressure to cause the shift.

With respect to charcoal use, low-income households buy charcoal in small amounts almost on a daily basis, but the small amounts tend to be the most expensive. Thus, perhaps the low-income households in towns have the highest expenditure per unit on cooking energy. The concept that there are longer-term savings with the use of efficient stoves has yet to be realized by most households. Against this situation, a combination of approaches will be required. These range from further technological improvements that focus not only on efficiencies but also on duration of use, low cost repair and other conveniences associated with the use of improved stoves. Included here is also the possibility of subsidizing these strategies using funds from taxes on the same wood energy resources and/or through levies on petroleum at central governments levels to enhance quality control.

Improved charcoal kilns

In charcoal production, improved kilns could contribute significantly to efficient production. Bailis (2003) reported that in earth-mound kiln, which is the most common method of making charcoal in sub-Saharan Africa, between five and ten tons of wood are needed to make 1 ton of charcoal (at a mass-based conversion efficiency of 10-20%). Thus, using such kiln between 60-80% of the wood's energy is lost in the production process of charcoal (Bailis, 2003). Experience from CHAPOSA (2002) shows that kiln efficiencies in Zambia ranged from 20-28% while in Mozambique the range was 14-20. In Tanzania, at an average of 19% kiln efficiency, 18 trees of 32 cm DBH (diameter at breast height, measured at 1.3 m) on average are used to produce 26 bags each weighing 53 kg of charcoal. That is 1 m^3 of wood yields 2.6 bags of about 53 kg of charcoal (CHAPOSA, 2002).

In spite of their efficiency the use of improved kilns has failed due to lack of capital for kiln construction. The need to process the billets into specific sizes and transport them to kiln sites is an added cost which is limiting. However, there is evidence that experienced producers who use traditional kilns achieve more efficiency than less experienced ones. This calls for studying the techniques used by the experienced producers and disseminate them to less experienced producers. According to CHAPOSA (2002) in Zambia a manual for best practice for charcoal making has been produced based on the experience of charcoal producers. In the current system there are no incentives for charcoal makers to adopt efficient production technologies, because of a combination of reasons, including: market failure; unrealistic fees and royalties; behaviour towards open access resources; weak monitoring of forests and reserves; haphazard issuance of permits (legal and otherwise); ignorance; long term problems associated with land and tree tenure/ownership and poor monitoring. These have to be addressed.

Improvement of kitchen management to save energy

At the household level adoption of improved kitchen management skills is also essential in reducing fuelwood consumption (Kaale, 2005). Such skills include:

- Use of dry firewood to increase burning efficiency

- Extinguishing fuelwood after cooking
- Pre-treatment of some food stuffs through soaking to reduce cooking time
- Construction of cooking shelters instead of cooking in the open to increase fuelwood utilization efficiency.

SOCIO-CULTURAL AND ECONOMIC ASPECTS OF CHARCOAL

Household dynamics in charcoal making

The economy of people in the charcoal producing areas largely depends on subsistence agriculture. There are three main charcoal producers in the charcoal market: *full time*, *seasonal* and *occasional producers*. Full time producers live in forest areas and produce charcoal throughout the year, shifting to new areas when the need arises such as when the resource becomes depleted. These are in most cases immigrants to the charcoal producing areas. In one of the active charcoal making areas in eastern Tanzania about 60% of charcoal makers are migrants from other parts of the country (Zahabu 2001). Seasonal producers practice agriculture as their main occupations and produce charcoal only in the off-farming season. Occasional producers make charcoal to meet specific cash needs during the year (CHAPOSA, 2002).

According to CHAPOSA (2002) in areas with reasonable accessibility, charcoal is the main cash crop of the rural households. In eastern Tanzania communities adjacent to the Morogoro – Dar es Salaam highway earn about USD 176 annually (Monela *et al.* 1993). Another study by Monela *et al*. (2000) revealed that about 278 bags of charcoal are produced per household per year which when sold at Tshs. 1000 (USD 1.6) about USD 445 was obtained. CHAPOSA (2002) revealed that on average each charcoal making household produce about 43 bags of charcoal per month which when sold provide an income of about USD 645 per year per household. This indicates a growing dependence on charcoal for household income whereby about 75% of farmers in charcoal producing areas had charcoal as an important source of income.

Similarly, household dependence on charcoal in other Sub-Saharan countries is widely reported (CHAPOSA, 2002). In the Licuati region south of Maputo, extractives activities such as charcoal making, fishing and local brewing were the main source of income in rural areas. The annual average household income is USD 690 per year of which USD 450 is derived from charcoal production. This was about 70% of the household cash income showing that charcoal provides a considerable income in rural areas. In Zambia, with the collapse of agricultural market, charcoal is virtually the only income source in rural areas.

The income from the sale of charcoal was also found to be above the minimum wage paid to most of the governments' employees. This has a consequence of attracting more people to engage in charcoal making. Migration to charcoal producing areas is common. In Tanzania 40% of the charcoal makers have no formal education (CHAPOSA 2002). This is because the activity requires neither formal education nor large capital investment although it is time consuming and labour intensive. The required labour is usually drawn from household members or other producers collaborating for specific tasks in the production process. While men carry out most of the production activities such as tree felling, cross-cutting and kiln building, women participate in breaking the kiln after carbonization and in recovering and bagging the charcoal (CHAPOSA, 2002; Brigham *et al*., 1996). Therefore given the low education level required, the income may attractive other people to join the business, and thus more deforestation to the woodlands.

Charcoal transportation and marketing

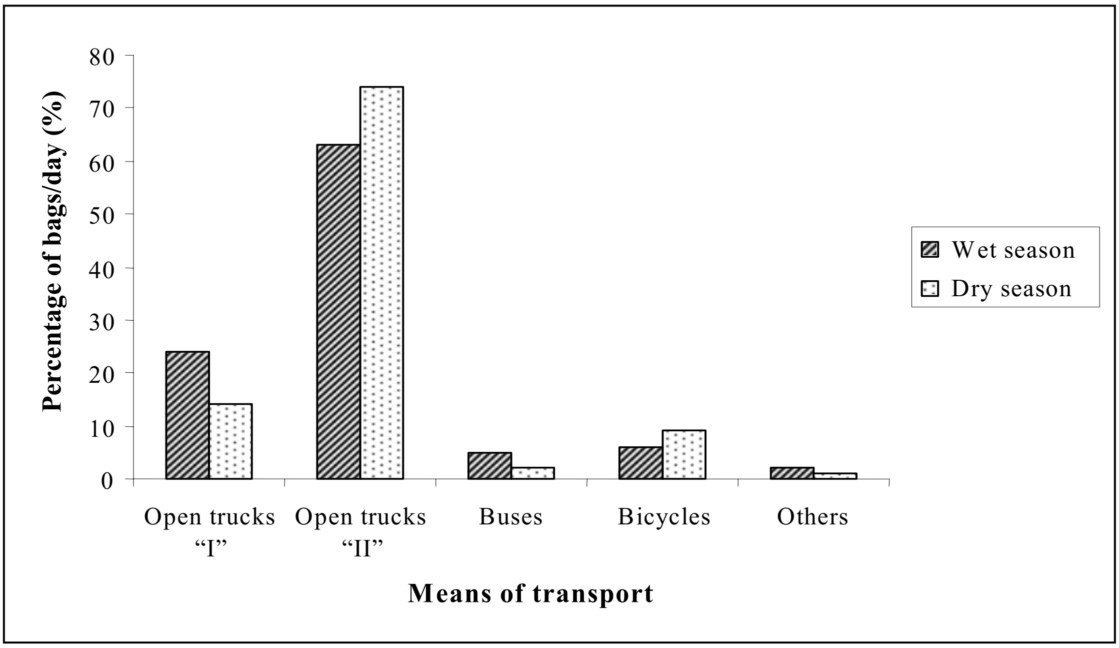
Charcoal productions sites are usually located close to access roads to allow simplify transportation and sale. Normally, charcoal kilns are located within 5 to 15 km (Brigham *et al*. 1996). However, as woodlands deplete on favourable distances or when preferred species are exhausted, charcoal producers move even further and take the burden of carrying charcoal loads to the roadside. For example, the depletion of preferred species in the vicinity of the Dar es Salaam – Morogoro highway has led to extensive woodland degradation and deforestation up to a distance of 30 km from the road to supply charcoal to Dar es Salaam city. The transport of charcoal from the kiln site to the roadside may be carried out by ox-carts, wheelbarrows, bicycles or on foot by head. As a result of increased labour costs involved in the movement, usually charcoal is sold at a higher price at the roadside than at the kiln site (Monela *et al*. 1993, Zahabu, 2001).

From the roadside, several means of transport are used to carry charcoal loads usually in bags weighing around 50 to 60 kg once packed with charcoal. In a study conducted by Malimbwi *et al*. (2004) along the major entrances to Dar es Salaam city, it was observed that the major means of transporting charcoal to the city could be grouped into five categories as follows:

- *Open trucks "I"*: all types of vehicles with a carrying capacity of 1 – 2 tons;
- *Open trucks "II"*: all types of vehicles with a carrying capacity greater than 2 tons;
- *Buses and Minibuses;*
- *Bicycles;* and *Others:* motorcycles, head loads and other types of vehicles (e.g. tankers and saloon cars).

Malimbwi *et al*. (2004) further observed that among the grouped means of transporting charcoal to Dar es Salaam (Figure 1), *Open trucks "II"* accounted for the highest daily load during the period of the study, accounting for about 88% of all charcoal entering Dar es Salaam City. Moreover, most of the charcoal is transported during morning hours (6:00 a.m. to 12:00 p.m.)

Figure 1. Means of charcoal transportation to Dar es Salaam during the wet and dry season



Source: Malimbwi et al. 2004

Despite bicycles hauling relatively smaller percentage (< 10%) all of charcoal to the city, they are the most frequent means of transporting charcoal. Cyclists accounted for about 63% and 70% of the daily means of charcoal transport to the city in the wet and dry seasons, respectively (Malimbwi *et al*., 2004). This seems to suggest that may be many people involved in charcoal business are poor who can not afford to pay for better means of transport, but are engaged in this business just to earn their living. The cyclists come in from production sites in the peri-urban and rural areas and deliver the charcoal to specific points just at the outskirts of the city and wait for city based consumers to come and buy the charcoal (e.g. Plate 1). The buyers are generally small charcoal traders with small businesses that use charcoal, but even some of the wealthier households buy charcoal from the cyclists. A few of the cyclists go to deliver to specific customers further into the city. The cyclists transporters may just deliver charcoal and get paid for it, or be actually involved in charcoal production and/or retailing sale.

Most of the charcoal transporters by trucks are traders who are licensed to transport and trade in charcoal or firewood (Monela *et al*., 1993). These traders usually use hired vehicles though a few use their own vehicles. Arrangements between transporters, traders and producers are informal and generally do not involve long-term contracts. Charcoal transporters are involved in the business due to the following reasons:

- It is a business with ready market in the urban areas
- The business requires neither high starting nor operating capital nor specialized skills to operate (Malimbwi *et al*., 2004).
- Transporters usually make good profit by transporting charcoal on the return trip to the city using the otherwise empty trucks after taking goods upcountry.

Difficult conditions under which charcoal transporters must operate make traders reluctant to use their own vehicles or new ones. Old age of most charcoal transporting trucks results in unreliability and frequent vehicle breakdown during transport (Mangue, 2000). During the rainy season vehicles often fail to reach production areas because of poor state of access roads, resulting in a reduction in charcoal supply and a seasonal slight increase in charcoal price (Mangue, 2000; Malimbwi *et al*., 2004). However, another explanation for the drop of charcoal supply during rainy season may be that at this time, seasonal producers turn to agricultural activities (Monela *et al*. 1993).

The profit margin in charcoal transportation and trade is relatively small, particularly for trucks in the dry season, which provide for a strong incentive to evade paying taxes and levies. Evasion is apparently through many means, including night time transportation which is forbidden for biomass resources and various forms of collusion and payments to guards at the check points (Malimbwi *et al*. 2004). In Zambia, it was also found that profits from the charcoal business are marginal both at production and retail stages. Yet, the business continue because of low opportunity costs in rural areas as a result of failure in the agriculture industry and decline in formal employment opportunities in urban areas. In many cases, charcoal production seems to happen out of necessity as a last resort to earn income to the rural households. Thus, lack of alternative income sources is a compelling factor for the decision to engage in charcoal production. Commercial production is only induced from urban centres (CHAPOSA, 2002).

Charcoal retailing in many African cities is very well structured so as to make charcoal accessible to different consumers. Charcoal prices do not increase in real terms, even though inflation causes the current prices to increase. In most African cities for at least the last two decades, urban consumers have been paying slightly less than US $ 0.10 per kg of charcoal (CHAPOSA, 2002). Charcoal is retailed in a variety of different quantities. At the one end of the retailing system there are outlets for bulk purchase that are often along main roads of cities. At the other end, there are small shops with some type of tin or other standard container used as measuring device or even some kind of heaps as measure for charcoal that are often found within very close proximity to the households, often less than 1-2 minutes walk (Mangue, 2000, CHAPOSA, 2002).

Figure 2. Bicycles loaded with charcoal waiting for customers, Kilwa Road, Dar es Salaam

Source: Malimbwi et al 2004

LEGAL ASPECTS AND POLICIES INFLUENCING WOOD FUEL SUPPLY AND USE

Land and tree tenure systems in Tanzania

During the colonial period, indigenous peoples' rights to harvest and dispose of trees was significantly restricted. Similarly, after independence, forest policies in many developing countries have been characterized by the strong concentration of power over forest resources in the central state apparatus, and the corresponding lack of local participation in forest and tree management. Failure to recognize indigenous systems of forest management and indigenous rights to resources at policy level has led to:

- loss of incentives by the local communities to protect trees-hence indiscriminate tree felling;
- discouragement of local people to engage in tree planting and reforestation projects; and
- excessive reliance by the state on punitive measures to enforce the law.

The present land tenure system in Tanzania for example, provides four main possibilities of acquiring land for one’s use as specified in the Land Act 1999 (MLHSD,1999b) as follows:

- Government leasehold (33, 66 and 99 years renewable)
- Right of occupancy (statutory or deemed);
- Customary land tenure; and
- Village land ownership.

In strictly ownership terms, land in Tanzania may be regarded as:

- General land - administered by the commissioners of lands;
- Reserved land - under statutory or other bodies
- Village land - administered by the village council.

It is from the general land where most charcoal is produced. Despite that the new Land Law in Tanzania recognizes the existence of customary rights of rural communities; ownership still remains strictly under the state. The government as the land owner has the power to revoke customary land rights, creating levels of land insecurity. It is now apparent that privatization offers a chance to introduce a private land hold.

Insecurity of tenure among others has promoted open access to forests and woodlands. Tenure determines whether local people are willing to participate in the management and protection of forests in terms of rights, ownership and access. If these are not well defined, effective participation of the local people in the management of the miombo woodlands may hardly be achieved. For the case of Tanzania it is therefore, stressed that the current Village Land Act of 1999 (MLHSD, 1999b) be put into action to make people own land and trees growing on the land. Thus, their participation in woodland management in public lands would be under the custodian of the Commissioner for Lands.

Past legal rules for charcoal making in Tanzania

The Forest Ordinance Cap. 389 which regulate the use of forests in the country divide forests into basically two categories: those forests reserved by the government for commercial exploitation or for conservation/protection of water sources and habitats among others and forests on the unreserved public (general) lands. It is clearly stipulated by law that no use of the reserved forest area is permitted without a license unless otherwise permitted by the Director of Forestry and Beekeeping Division, the District or under the Ordinance or other lawful authority (§ 56(1) of the Forests Ordinance).

The Forest Rules of 1959 as amended specify fees for licenses and methods for marking and identifying timber taken from forest reserves. It includes also permits for grazing, cultivating, building and residing in the forest reserves. Local Governments Act 1982 give both Village and District governments explicit authority to regulate the use of forests and forest produce (§ 118(1)(b), 118(2)(n) and the First Schedule of the District Authorities Act). However, the Forest Ordinance does not directly impact the production of charcoal because charcoal is regarded as a secondary product from harvested or gathered timber. In the current legal framework, only registration form is issued to charcoal dealers. The registration fee is TAS 50,000/= paid to the government through regional or district forest office. In addition, the dealer is charged a levy per bag which is set in accordance with the district council's by-laws. Such levies therefore differ from one district to another. With the current alarming rate of woodland degradation in Tanzania due to excessive charcoal making, the government has decided to take immediate measures to set a new charcoal making procedure in order to reduce if not contain the unlawful charcoal making.

Recent regulations and amendments for charcoal making in Tanzania

According to the recent regulations for charcoal preparation, transportation and selling of 2006 (URT, 2006) amendments to the Forest Act No. 14 of 2002 (URT 2002), it is required that District harvesting committee be established and charged with the roles to prepare and maintain a register of all charcoal dealers in the district under the custodian of the District Forest Office. The local government in turn, shall, in areas of jurisdiction, set special areas for preparation and selling of charcoal. Also every village shall prepare and maintain a roll of charcoal dealers and no person shall prepare charcoal unless:

a) the activity is undertaken in areas set by the Committee;
b) the trees used have been selected as provided under the district harvesting plan;
c) a pit has been dug for that purpose;
d) the charcoal is prepared in the manner provided in the harvesting plan; and
e) in the area where trees have been felled, trees are planted and maintained by such person, either alone or in group, as the case may be; however, trees under this paragraph may be replanted in any other area as may be directed by the village responsible for that area.

Implementation of the first four rules needs only effective monitoring. The last rule is difficult to implement if charcoal making is done in the dry season when tree planting is not possible.

The rules emphasize further that any charcoal prepared, must comply to any fee, levy or charge by the village government, the Committee or any other relevant authority. However, a survey by CHAPOSA (2002) showed that 75% of the 24,000 bags of charcoal consumed daily in Dar es Salaam city are not accounted for at the checkpoints. It is also doubtful if the charcoal making rules are followed.

Relevant sector policies related to woodfuel production

Several sectors have reviewed their policies as a response to the Poverty Reduction Strategy Paper popularly known as *Mkukuta* in Kiswahili in Tanzania. Sectors that are related to wood energy include forestry, energy, agriculture and livestock, environment, wildlife, fishery, science and technology, women and gender development.

The Forest Policy

The first Forest Policy of Tanzania was published in 1953 and revised after 45 years in 1998 (URT 1998). Salient features of the current forest policy that did not surface in the old policy include

- The goal is enhance the contribution of the forest sector for the sustainable development of Tanzania and the conservation and management of present and future generations
- Recognition of farmland trees as a major source of firewood for rural communities
- Singles out deforestation due to charcoal production, agriculture expansion, overgrazing, wildfires and overexploitation of other wood resources as the major problem facing the forest sector. Estimates deforestation rate at 130,000 to 500,000 ha per annum
- Recognizes government failure to protect forest reserves due to inadequate resources and recommends collaborative management initiatives as possible solution
- Recognizes the contribution of wood fuel to the energy balance and its dwindling supply. Consequently encourages tree planting for woodfuel, use of efficient

conversion technologies and promotion of affordable energy alternatives as strategies to address the woodfuel crisis.

The Energy Policy

The first National Energy Policy was published in 1992 and revised in 2003 (MEM 2003). The policy has the following salient features

- The vision of the energy sector is to effectively contribute to the growth of the national economy and hereby improve the standards of living for the entire nation in a sustainable and environmentally sound manner
- The mission of the energy sector is, to create conditions for the provision of safe, reliable, efficient, cost-effective and environmentally appropriate energy services to all sectors on a sustainable basis.
- The policy provides a very comprehensive analysis of the energy supply and demand situation in Tanzania, including wood fuel and other renewable energy sources.
- The policy states that *"Wood fuel for the foreseeable future will remain the main energy source".* To ensure sustainable supply of biomass fuels, the policy emphasizes that *"Biomass, particularly woodfuel should be conserved through efficient conversion and end-use technologies which could be complemented by tree growing at household level and beyond".*

In view of the above, it can be observed that the policy gives high emphasis on the need to sustain rural energy and in particular wood fuel. It also promotes efficient wood fuel conservation and end-use technologies in order to save resources: reduce rate of deforestation and land degradation: and minimizing threats on climate change. This feature is also observed in the forest policy. Although A Renewable Energy Fund has been provided for in the Energy policy, it is not yet operational. One of its possible uses could be to meet cost of mainstreaming certification of woodfuel.

The Agriculture Policy

The Agriculture Policy calls for timely delivery and efficient use of energy inputs, including renewable energy sources into agriculture. It emphasizes the need for agricultural sector to collaborate with forestry in environmental conservation programs. It specifically singles out tobacco production as a cause of deforestation and encourages tobacco farmers to plant trees to meet their woodfuel requirement for tobacco curing.

The Agricultural Sector Development Strategy (URT 2001) developed to implement the policy advocates the use of animal manure for biogas production and planting of nitrogen fixing trees in agroforestry systems in order to increase agricultural production and provide firewood to rural communities.

WOODFUEL PROJECTS IN TANZANIA

There few woodfuel projects established in Tanzania. However only two are targeted to produce charcoal. These are The Ruvu Fuelwood Pilot Project and The Maseyu Eco-Charcoal

The Ruvu Fuelwood Pilot Project

The Ruvu Fuelwood Pilot Project (RFPP) which started in 2000 is located in North Ruvu Forest Reserve, about 60 Km west of Dar es Salaam (MNRT, 2004). Being a production forest, closer and accessible to Dar es Salaam, North Ruvu Forest Reserve which covers a total 67, 000 ha is a victim of severe degradation due to woodfuel exploitation for the urban population. About 80% of Dar es Salaam city population depend on wood fuel as a first choice domestic energy. About 1900 ha have been provided by the government under special agreement with 670 households which have been allocated 3 ha plots each to be planted with agroforestry tree species which potential as woodfuel. The participating villages are Kongowe Msangani, Mkuza, and Mwendapole. The planted tree species *are Acacia crassicarpa, A mangium, Brachystea kirkii, Khaya anthotheca, casuarinas equisetifolia, Senna seamea, and Eucalyptus terreticornis*. Insitu conservation of *Afzelia quanzensis, Dalbergia melanoxylon, Jurbernardia magnistipula*, and *Khaya anthotheca* is also practiced. The average production in farmer managed plots is 6.3m^3/ha/yr compared to 0.96 m^3/ha/yr in non managed areas. The project has trained farmers on growing wood fuel trees how make charcoal kilns and firewood stoves. Between 2000 and 2004 a total of 1,240,000 trees of different species have been planted (Kaale 2005). This is essentially a participatory one. The main goal is to promote sustainable forest resources management, through increasing forest regeneration and forest products to meet rural and urban primary energy requirements, while providing realistic economic base for the communities surrounding the forest reserve.

The Maseyu Eco-Charcoal

Maseyu is a village 40 km from Morogoro on the Dar es Salaam highway in an area where the production of charcoal is a major business with a long tradition.

The production of Maseyu Eco-Charcoal has two goals: The improvement of the livelihood of the producers of charcoal and the sustainable use of wood as an important natural resource. These two goals are achieved by:

1. Tree nursing and woodland management: to ensure sustainable production and thereby the source of income trees are being nursed continuously to replace the wood used for charcoal

2. Efficient production: with improved brick kilns less wood is needed to produce the same amount of charcoal (3-4 tonnes of wood per tonne of charcoal)

3. Marketing: sustainable Eco-Charcoal will be sold directly to big consumers and in special places (e.g. hotels, supermarkets), assuring a better remuneration of the producers. The intent to help shifting charcoal business from the informal to the formal sector of Tanzania's economy is an important additional goal of this initiative.

Since February 2006,40 villagers from Maseyu organised in two charcoal groups have nursed 80 000 trees, most of them indigenous Mgunga (*Acacia polyacantha*). Burned bricks have been made locally and the first improved half-orange-shaped kiln was built in which carbonization trials have started in October 2006. The project aims at 5 charcoal groups operating 5-10 kilns. The eventual goal of the project is to certify the charcoal from this project.

To achieve this Eco-Charcoal has the following stakeholders. The local stakeholders are the Maseyu village and the Wami-Mbiki Society, a CBO of 24 villages with the goals of sustainable wildlife management and improvement of well being in its communities, while ESDA (Energy for Sustainable Development Africa) provides the technical backstopping. This pilot is funded by RLDC (Rural Livelihood Development Company) who acts as a facilitator with funds from SDC (Swiss Agency for Development and Cooperation)

TANWAT (Tanganyika Wattle Company)

TANWAT was founded in 1949, when the Commonwealth Development Corporation (CDC) took responsibility for a forest development project set up two years earlier by the Forest, Land Timber and Railways Company, located in the Southern Highlands of Tanzania with

15,000 hectares of private forest business (TaTEDO 2004). Production of tannin from wattle was the major source of revenue for the business until late 1960's when a decline in demand for leather goods, brought about by availability of cheaper synthetic alternatives. This resulted in an initiative aimed at exploring new global forestry product opportunities, reducing reliance on tannin products and creating prospects for increased revenue on a long-term basis. The Tanganyika Wattle Company is a fully owned subsidiary of CDC capital fund.

The forest estate comprises 8000 hectares of wattle trees, 4000 hectares of pine and 1000 hectares of eucalyptus. The wattle bark is rich in tannin. The bark is separated from the wood in the field and transported to the factory for processing and manufacture of wattle extract. The wood, which is effectively a waste product, is transported to the power station for use as fuelwood for boilers. At the current wattle extract production levels, wood volumes in excess of 60,000 tonnes are available per annum. Once the tannin has been boiled out, the (waste) bark provides a further fuel source for the boilers. At current production levels, 10,000 tonnes of spent barks is available per annum the eucalyptus in the forest is available in a range of species, some of which are not suitable for conversion into poles. Planting of these species has been discontinued but there is a residual 60,000 tonnes available in the forest (TaTEDO 2004).The sawmill produces 3,000 tonnes sawn timber per annum at a recovery rate of 40% from the pine trees. As such, 4500 tonnes of pine waste is produced per annum, comprising off-cuts and sawdust.

The Tanzania's first commercial wood-fired power plant was commissioned in mid 1995 with an installed capacity of 2.5MW. The plant provides power to the Njombe/TANESCO mini grid. The plant is composed of fuel handling and processing facilities that include a hydraulic feeder or logger, a drum chipper with a capacity of $70m^3$ loose chips per hour, chip belt conveyor and two silos, each capable of storing 17 tons of chips. Sustainability of raw material supply is achieved by adhering to the annual planting target of 1200ha (900Wattle, 100ha Eucalyptus and 200ha Pine). At harvesting the wood productivity is 80T/ha Wattle, 400 m^3ha^{-1} Pine and 300T/ha Eucalyptus (Aza Mbaga 2007, personal communication.[9]) The rotation ages are 10 years for Wattle, 20 years for Pine and 10 -12 for Eucalyptus. Kibena Tea Ltd, Njombe (Section 7.5 below) meets her firewood requirement for curing tea from TANWAT.

Kibena Tea Limited, Njombe

Produces tea at the rate of 3500m tons/yr from a 700 ha farm. (Miraji Gembe, 2007, personal Communication). The tea is steam cured using firewood from Eucalyptus and wattle wood. It takes 1 m^3 or 0.65 tons of dry wood to cure 350 kg of tea. With an annual capacity of producing 3.5 kg of tea the total amount of wood needed annually is $10{,}000m^3$. Kibena Tea Ltd have contracted TANWAT to produce the required firewood, and have not faced any problems regarding supply of firewood. Assuming productivity of 300 m^3ha^{-1} at harvesting, about 35 ha of plantation need to be harvested annually

Wakulima Tea Company Ltd, Tukuyu

This company has the capacity to produce up to 3985 tons per year. The tea is steam cured using firewood from Eucalyptus grown by outgrowers. One m^3 of wood costs TAS 7000 at the factory at it can cure 332 kg of tea. The annual requirement of wood for tea is therefore 12000 m^3. The factory prefers mature wood which has hire calorific value but since the wood comes from different out growers there is high variation in maturity. Availability of firewood during the rain season is also a problem due to poor accessibility and increased distance to the

[9] Aza Mbaga is the Chief Forest Manager at TANWAT

resource. The company is considering producing there own firewood and they have set aside 80 ha for planting Eucalyptus. Otherwise future firewood supply may not be sustainable

Other tea companies in Tanzania

Other tea companies using woodfuel for curing tea but whose details could not be obtained include Mufindi Tea Company - Mufindi, Herkulu Lushoto, East Usambara Tea Company - Tanga (Amani).

WOODFUEL CERTIFICATION

What is certification?

Forest Certification is a process designed to ensure that forests are well managed and that the interests of local people are protected. It helps to ensure that forests are managed properly - so that they can continue to provide benefits and services for current and future generations. Certification provides assurance that people who live in or close to the forest must benefit from its management and use. Under proper forest certification schemes, independent auditors issue a certificate to the forest manager after the quality of forest management has been assessed using nationally agreed standards that meet internationally agreed principles. Once a certificate is given, the auditor makes annual follow-up visits to ensure that the forest continues to be managed to the agreed standard. Forest certification therefore is a process that leads to the issue of a certificate by an independent party, which verifies that an area of forest is managed to a defined standard.

Requirements for forest certification

The credibility of certification as key to sustainable forest management hinges on the following requirements:

- The standard has been defined and accepted by stakeholders - local people, forest owners, industry, government, consumers
- The standard is compatible with globally acceptable principles that balance economic, ecological and social objectives
- There is independent and credible verification with reporting of results to stakeholders, Certification and the market place
- Certified products can carry a label, which verifies that the timber or wood product originates from well-managed forests
- Companies in the supply chain hold chain of custody certificates so that the label can follow the wood from the forest to the consumer.

Steps in certification process

Preparing for certification

This involves development of certification standards for sustainable forest management based on Principles and Criteria for the national context by supplementing them with relevant indicators. These national standards provide detailed and specific management requirements. In the absence of nationally adapted certification standards such guidance will be provided by the certifiers using generic or local interim standards. The certification standards, though not designed as a forest management manual, provide clear objectives. Certification itself adds the incentive to achieve those objectives.

Also at this stage preliminary visit (scoping visit) is carried out by the certifier. Scoping visits identify major strengths and weaknesses based on a briefing with the managers and/or a rough estimation of the applicant performance. This helps the enterprise preparing for certification to deal with any major gaps before the full assessment.

Field assessment

Although certifiers have to remain independent of other interests, and therefore are not allowed to provide consultancy services to an operation they certify, in practice the field assessment serves as an informal training opportunity concerning how to reach certification standards. When the assessors interview forest managers and operators about the performance of the operation under investigation the discussions provide a lot of useful hints and recommendations to those involved.

Meeting the conditions

The third phase starts when certification has been achieved, but conditionally on certain improvements. The summary of field results provided in the certification report identifies strengths and weaknesses of an operation. It indicates to forest managers what needs to be consolidated and what needs to be improved. It normally contains a list of corrective actions, or conditions, that have to be met within a given time-frame. If there are major issues these have to be met (and will be checked) before a certificate can be granted. Minor issues can be dealt with subsequently. Together with specific recommendations it provides a clear guide to what kind of training or other measure might be needed to address any areas of non-compliance with the standards. The regular (at least annual) monitoring visits by the certifier ensure that the corrective actions are followed up.

Production of certified charcoal in Tanzania

Relevance of certification of woodfuel in Tanzania

About 80 percent of all wood used in the tropics each year is consumed as fuel, mainly as firewood, in the country of origin. Firewood is the primary source of energy for hundreds of millions of people who do not have access to fossil fuels, or can not afford them. The remaining 20 per cent of the yearly production of tropical wood is used as industrial timber, of which four-fifths are also consumed in the country of origin (Julio 1997). Woodfuel extraction is therefore the principle factor responsible for deforestation in Tropical countries including Tanzania.

Tanzania has a total area of about 94.5 million ha out of which 88.6 million ha is covered by landmass and the rest is inland water. Forests cover about 34 million hectare of the total land area. There are 13.9 million hectares of declared forest reserves in a country of which 12.3 million (81.5%) are under central government and the rest under local governments (district/town or city councils) and private ownership. Village Forest Reserves cover about 3 million ha. These are under Collaborative Forests Management (CBFM) an initiative that was introduced in Tanzania in the early 1980's with some experiences of success stories from Nepal and India. The practice is already legitimized by the parliament through the current forest act of 2002. Most of the CBFM forests are demarcated as part of village general land. Thus they are also called village forest reserves. There are more than 9000 villages in Tanzania but currently CBFM is confined to only a few.

Apart from the aforesaid different forest management regimes in place, current statistics also reveal that the remaining forest area in general land is about 18 million ha. These forests are "open access" characterized with insecure land tenure, shifting cultivation, harvesting for woodfuel, poles and timber, and heavy pressure for conversion to other competing land uses, such as agriculture, livestock grazing, settlements, industrial development in addition to wild fires. The rate of deforestation in Tanzania which is estimated at more than 500,000 hectares per annum is mostly impacting such general land forests. On the other hand reforestation and aforestation activities by private and local communities are also done in general land areas. Therefore there is a room for much more sustainable forest management activities that may alter the observed high rate of deforestation in the country. Forest certification may offer a better control for forest exploitation for both reserved and unreserved forests in the country.

Criteria and indicators for the production cycles

The first set of internationally agreed guidelines and criteria for sustainable forest management are those of the International Tropical Timber Organization, ITTO. The commitment of tropical countries to manage production forests according to these criteria is thus part of an international agreement, under the auspices of the United Nations. Most tropical countries continue to support this unique and challenging commitment (Julio 1997). Other certification systems in practice are

- The Forest Stewardship Council (FSC)
- Program for the Endorsement of Forest certification (PEFC) Council
- Canadian Standards Association (CSA)
- Sustainable Forest Initiative (SFI)
- The Indonesian Eco labeling Institute (LEI)
- Malaysian Timber Certification Council (MTCC)
- The Austrian Forestry Standard (AFS)

Different users and stakeholders have different expectations of a certification scheme. Potential users decide which one or more of the available are credible for their purposes. Forest management standards are the yardstick by which the performance of a forest manager is assessed for certification purposes. The standards should balance the economic, ecological and social equity dimensions of forest management. For the certification scheme to be credible, all major stakeholders should participate in the process for defining the standards.

Criteria and indicators are tools which will help guide national policies, regulations and legislation, and which will guide monitoring and reporting on status and overall trends in forest management. Desirable developments will be demonstrated by positive aggregate trends in the identified indicators. Based on information on the trends at national level, and on forecasts for the future based on these, policy and decision making can be rationalised and action can be adjusted and improved. There appears to be growing international consensus on the key elements of sustainable forest management. Seven common thematic areas of sustainable forest management have emerged based on the regional and international criteria and indicators initiatives:

- Extent of forest resources
- Biological diversity
- Forest health and vitality
- Productive functions and forest resources
- Protective functions of forest resources
- Socio-economic functions
- Legal, policy and institutional framework.

Criteria and Indicators of charcoal certification in Tanzania

Although not much explicitly for charcoal production the thematic areas may be used in setting the criteria and indicators for charcoal certification in Tanzania, with additions to encompass charcoal from plantations and natural forests. The proposed C&I for sustainable production of woodfuel in Tanzania are presented as Appendix 1 of this report. The following sources of Criteria and Indicators were consulted in compiling the criteria and indicators

- The Analysis of sustainable fuelwood and charcoal production systems in Nepal (Bhattarai and Shrestha 2007)
- The Tarapoto Proposal of Criteria and Indicators for Sustainability of the Amazon Forest (ACT, 1995)
- International Tropical Timber Organization (ITTO) (Anon. 1998 a)
- African Timber Organization (ATO) (Anon. 1998 b)
- The CIFOR Criteria and Indicators Generic Template (CIFOR, 1999)
- Criteria and Indicators for SADC countries within the framework of the Dry-Zone Africa Process (Anon. 1999)

Tanzania is member to the SADC and ATO. Some of the features of these C&I are therefore related to Tanzanian policy. For example the establishment of a Forest Service in charge of the management of all the forests as a necessary indicator in the institutional framework is currently an ongoing process in Tanzania.

The implementation of C&I developed for a particular product and country involve several stakeholders. Similarly rigorous consultations are pre requisite during preparation of C&I. In Malaysia final C&I for woodfuel were compiled by an appointed committee of stakeholders assigned to refine the C&I in addition to identification of activities for each indicator (Tang, 2001). This is a necessary step for the Tanzanian case whereby the current document should form the draft for the final document acceptable to relevant stakeholders.

Constraints for woodfuel certification in Tanzania

Although woodfuel certification is still lacking in Tanzania, the following limitations are foreseen:

<u>Lack of proper management plans</u>

As is the case with most developing countries there is no reliable data on forest extent, characteristics, and growth and yield because national forest inventory is not carried out (FAO, 2006) due to limited capacity in terms of number of staff and finance. This has lead to poor forest management because of lack of data for making informed management decisions. The Tanzania forest policy (URT, 1998) and its forest act (URT, 2002) clearly stipulate the need for proper forest management based on specific forest management plans but except for private forests there is hardly a forest reserve with a proper management plan. This could affect the certification process.

<u>Insecure land tenure</u>

Long-term tenure and use rights to the land and forest resources are required for the forest certification. In Tanzania most of the land is under local communities with customary tenure or use right but not formally surveyed and mapped. As such sometimes land may be set aside by the government for other uses including establishment of private forests. When such circumstances happen, disputes of substantial magnitude involving a significant number of interests normally occur. This may affect the certification process unless clear evidence of long-term forestland use rights (e.g. land title, customary rights, or lease agreements) is demonstrated. It is required that local communities with legal or customary tenure or use rights shall maintain control, to the extent necessary to protect their rights or resources, over forest operations unless they delegate control with free and informed consent to other agencies.

Lack of local certifying agencies

World wide certifications generally have had support from local and international NGOs, government and bilateral aid organizations. However, in Tanzania currently there are not local supporting organizations for the certification process. Lack of local organizations means additional costs for the certification process, as it has to be carried out by expatriates. The costs of certification include both direct assessment costs as well as indirect costs to improve management practices and to meet certification requirements. Such costs are high and a burden for any small-scale enterprise. In this respect woodland management for charcoal production will be difficulty to cover these costs. This is the case with most community based forest management projects and small private forestlands. Economies of scale do not favour any of these operations and appropriate solutions will need to be found for each of them.

Equally important at the national level, certification initiatives and associated standard setting processes facilitate a redefinition of roles and responsibilities with regard to forest management. However, there is so far no clearly developed national or regional forest certification systems based on broad stakeholder consensus and acceptance. This to a greater extent will limit certification process in Tanzania.

Uncertainty of the market for certified woodfuel

Experiences with forest certification show that contrary to expectations frequently raised by NGOs and donors, certification has no mechanism to facilitate consistent access to the market potential for certified products (Irvine, 2002). The certification, as it has been structured to date, reinforces an existing trend which is for forestry products to try to enter international markets. This requires the creation of higher order regional processing and marketing structures, as well as closer links with industry. The lack of domestic markets for certified products is especially problematic for forest enterprises. Because certification is at an early stage in its development as a market tool, certified markets still represent a high risk for most forest enterprises. This could be minimized by developing certification trade networks in different parts of the world and retail companies. However large-scale industrial producers are more likely to be able to provide the needed quantities and qualities to out-compete small scale enterprises.

Lack of awareness among stakeholders

Forest certification is still a new concept in Tanzania. As such effort are needed to raise awareness among deferent stakeholders including foresters, environmental and conservation organisations, loggers, forest dwellers, research and academic institutions, social and human rights advocacy groups, indigenous communities, development and aid organisations, government representatives, timber trade dealers and associations, and concerned individuals. It is also important not to forget groups which are often excluded from decision making processes such as underrepresented social and ethnic groups, women, youth, rural communities, land owners, and foresters.

Policy options necessary to support certified wood fuel production

The local existing markets in Tanzania offer very low value and therefore low prices for charcoal. This is because wood for charcoal has been regarded as a free good that require just the producer effort to extract. To a great extent this situation is brought about by the fact that forests from which the woodfuel is extracted are not managed. Policy interventions to support sustainable forest management of the charcoal producing woodlands should therefore be developed. This may be building on woodfuel certification that among other things ensures that charcoal in the market is produced from sustainably managed forests.

Increasing stakeholders' awareness in participation, and benefits from forestry certification will require strategies that:

- Allow time for markets to develop for certified products so that risks to investors are reduced;
- Build on local market conditions and opportunities;
- Provide adequate time and space for the development of appropriate local institutions;
- Develop effective partnerships for training, technical assistance, processing and marketing appropriate to local goals;
- Include feedback mechanisms for mutual learning so that local knowledge and wisdom can also inform international trade institutions so they can be more responsive to equity and sustainability issues.

On the light of these strategies the following research areas are proposed:

- Development of standards for woodfuel forests management in Tanzania
- Development of participatory forest assessment techniques in order to capacitate different forestry practitioners and provide them will appropriate monitoring tools
- Applied research on efficient woodfuel production, processing (packaging, labelling and branding) and marketing
- Applied research on efficient woodfuel storage and use
- Applied research on development of appropriate local institutions to support the certification process
- Applied research on the development of market for certified wood

PROPOSED CRITERIA AND INDICATORS OF CHARCOAL CERTIFICATION IN TANZANIA

PRINCIPLE 1. POLICY, PLANNING AND INSTITUTIONAL FRAMEWORK

This principle involves the government commitment to support sustainable forest management in harmony with national and international laws and policies

Criterion 1.1. Government commitment to support sustainable forest management for woodfuel production

Indicators:

- *Appropriate political and legal framework that stimulates sustainable development*
- *Clear and focused policy statements supporting sustainable forest management*
- *Existence of a forestry service in charge of the management of all the forests, with adequate staffing to fulfil its mandate*

Criterion 1.2. Policy formulation and implementation are carried out in a participatory manner.

Indicators:

- *Existence of a mechanism for enhancing participatory policy formulation*
- *Existence of multi-sectoral interactions during policy formulation and implementation*

- *Regularity of meetings, discussions and other forums for which records of minutes of meetings prepared and made available*
- *Policy statements in non-forestry sectors (e.g. Agriculture, Energy, Fisheries) that recognizes and supports sustainable forest management for woodfuel production*

Criterion 1.3. Recognition of international laws and conventions addressing forestry and other environmental issues

Indicators:

- *Capacity to represent the country to international instruments and conventions to which the country is part of (e.g. ILO, CITES, ITTO, FAO, ATO, UNCED)*
- *Compliance of government circulars and directives to provisions of international laws*

Criterion 1.4. Extent of the forest resource well defined

Indicators:

- *There exists a map showing the boundaries of the forests.*
- *The boundaries of the forests estate are well marked on the field.*
- *Areas and percentages of forest lands and non forest land that produce woodfuel, in relation to total land area are known*
- *No evidence of forest encroachment*

Criterion 1.5 Effective structure for the promotion of private forestry and trees outside the forests (ToF)

Indicators:

- *Effective institutional support for commercial production of woodfuel from private forestry and TOF*
- *Existence of inter-sectoral coordination between sectors related to forestry*

PRINCIPLE 2: CONSERVATION OF BIODIVERSITY AND MAINTANANCE OF ECOSYSTEM FOR ENVIRONMENTAL PROTECTION ENHANCED

Criterion 2.1 Conservation of biodiversity in natural and planted forests at all tenure levels (e.g. government forests, private forests, community forests)

Indicators:

- *Diversity of habitat in terms of flora and fauna maintained*
- *Identification of endangered, rare and threatened species that should be exempted from woodfuel production*
- *Identification and zonation of biodiversity hotspots of flora and fauna that should be protected from any disturbance*
- *Species richness maintained*
- *Other specific management activities in place to conserve biodiversity of special biological interest, such as seed trees, nesting sites, niches and keystone species*

Criterion 2.2 Ecosystem and protective functions of the forest maintained

Indicators:

- *Special provisions for the protection of sensitive areas, plains, stream banks, steep slopes should be defined*

- *Erosion and other forms of soil degradation are minimized (sensitive areas identified and appropriate control measures applied)*
- *Soil and water restoration programs are implemented when necessary*

Criterion 2.3 Forest health and vitality maintained or improved

Forest condition and health can be affected by a variety of human actions and natural occurrences, from air pollution, fire, flooding and storms to insects and disease.

Indicators:

- *Absence of damaging human activities such as: encroachment, agriculture, roads, mining, dams, unplanned fire, nomadic grazing, illegal exploitation, inappropriate harvesting practices, hunting, and other forms of forest damage such as change in hydrological regime, pollution, introduction of harmful exotic plant and animal species.*
- *Degree of forest damage by natural causes: wild fire, drought, storms or natural catastrophes, pests and diseases, and other natural causes*
- *Existence of procedures to prevent/control: fires, diseases and pests*

PRINCIPLE 3 SOCIO-ECONOMIC FUNCTIONS ARE SUSTAINED

Criterion 3.1 Improved income through sustainable production and consumption of woodfuel

Indicators:

- *Employment generation from woodfuel production activities in relation to total national employment.*
- *Average per capita income in different woodfuel production activities.*
- *Efficiency and competitiveness of woodfuel production and processing systems*
- *This includes improved kiln efficiency and minimization of waste through briquetting in charcoal making.*
- *Economic profitability of management of the forests for woodfuel production.*
- *Sustainable production, consumption and extraction of woodfuel.*

Criterion 3.2. Investment and Economic Growth in the Forest Sector

Indicators:

- *Annual investment in woodfuel plantations, sustainable forest management and conservation in relation to total forest sector investment.*
- *Aggregate value of sustainable woodfuel production.*
- *Rate of return on investment on sustainable production of woodfuel, compared with rates of return in other sources of energy, considering all costs and benefits.*

Criterion 3.3 Enhanced Cultural, and Social Values

Indicators

- *Level of reduction of drudgery for women and children as a result of sustainable availability of woodfuel*
- *Level of participation of local populations in the management and in the benefits generated by woodfuel production activities.*
- *Absence of activities that compromise human culture*

PRINCIPLE 4: FOREST (WOOD ENERGY) RESOURCE MANAGEMENT INCREASES BENEFITS THROUGH BETTER FOREST MANAGEMENT

Criterion 4.1 Effective local management in place for maintaining and assessing the forest (wood energy) resources.

Indicators:

- *Ownership and use rights to resources are clear and respected*
- *Rules and norms of resources use are successfully enforced and monitored (existence of rules and norms, patrolling, incidences of violation of rules, number of forest offence cases registered, etc).*
- *Effective and accepted conflict management mechanisms in place (number of cases resolved).*
- *Access to forest (wood energy) resources is perceived locally to be fair (deprived and poor users get fair concession, access to woodfuel and NTFP, evidence of discussion in meetings on access to resources, attendance of gender, class, and ethnicity in meetings).*
- *Local people feel secure about their access to forest resources, including woodfuels.*

Criterion. 4.2 Stakeholders get equitable share from the benefits of forest (wood energy) resource management.

Indicators:

- *Mechanisms for equitable benefit sharing are developed and implemented (local people express satisfaction on the benefits received)*
- *Employment opportunities exist for poor and deprived users (number of such people involved in carpentry works, livestock raring, fuelwood collection for trade, charcoal making and other income raising activities).*

Criterion 4.3 All production forests under different systems of management be considered as means of livelihood by rural communities

Indicators:

- *The above people invest significant amount of time and efforts in wood energy resource management.*
- *Destruction of natural resources by the local people is rare.*
- *Maximum utilization of the productive national forests (all types) by local forestry stakeholders.*

PRINCIPLE 5: YIELD AND QUALITY OF DESIRED FORESTRY GOODS AND SERVICES ARE SUSTAINABLE

Criterion 5.1 Forest management units are implemented on the basis of legal ownership, scientific forestry practices and recognized traditional rights.

Indicators:

- *Forest management takes place on the basis of inventory information and relevant silvicultural practices.*
- *Information on the identity, location and population of communities living in the vicinity of the managed forests exist*

Criterion 5.2 Management plans are detailed and clearly documented.

Indicators:

- *Management objectives (both long-and short-term) are clearly stated reflecting the condition of forest, expressed public interest of the forestry goods and services, and the local forest users needs.*
- *Harvesting plans are in place taking into consideration available stock and capacity of forest staff to monitor operations.*
- *Forest Working Plan is comprehensive (identifies boundaries, provide inventory of resources, protection, includes management and utilization plans, biodiversity hot spots and cultural and conservation areas).*
- *Appropriate involvement of stakeholders in Management Plan preparation and takes into account all components and functions of the forest (i.e. timber, woodfuel, NTFP etc).*
- *Yield regulation by area and/or volume is prescribed in Forest Harvesting Plan (allowable cuts, minimum exploitable diameter, number of trees or total volume to be harvested per year etc).*
- *Silvicultural systems are prescribed and are appropriate to forest types.*
- *Prescribed harvesting systems and equipment match the condition of forest in order to reduce impact.*
- *Forest Management/Harvesting Plan is periodically revised and approved by the Director of Forestry and Beekeeping*
- *Programs and estimated costs of forest management activities are covered in the Management Plan on a priority basis.*

Criterion 5.3 Effective monitoring system is implemented

Indicators:

- *Mechanisms for monitoring and evaluation are clearly described in the Forest Working/Operational Plan, including chain of custody monitoring of products.*
- *Documentation and record of all forest management and forest activities are kept in forms that enable monitoring, also for product tracking during transportation and transformation*

Criterion 5.4 Costs and benefits from all types of forests are properly accounted for, distributed and shared among relevant stakeholders

Indicators:

- *Mechanisms for sale and/or equitable distribution of forest products (including woodfuels) to relevant stakeholders are clearly described in the Harvesting Plan*
- *Re-investment of the benefits from forestry management for forestry development.*

Criterion 5.5 Promotion of user and environment friendly wood energy technologies, government initiatives of R & D on woody and non-woody biomass based modern energy applications

Indicators:

- *List of environment friendly modern wood energy technologies relevant to Tanzania.*

- *Priority R & D areas in modern wood energy applications (i.e. technologies and end-uses).*
- *Priority R & D areas in non-wood biomass based modern energy applications (i.e. technologies and end-uses).*

PRINCIPLE 6: TECHNOLOGIES USED FOR CHARCOAL MAKING ARE EFFICIENT (PRODUCE HIGHER OUTPUT), NON-HAZARDOUS TO CHARCOAL MAKERS AND LEAST POLLUTING TO THE ENVIRONMENT

Criterion 6.1 Fuelwood supply sources are sustainable and the supply is legal

Indicators:

- *Supply sources (national forests) are under sustainable management.*
- *Fuelwood procurement is legal with payment of royalty fee, taxes etc.*
- *Record of every batch of fuelwood purchase, charcoal production and trade maintained, including number of people employed by gender and ethnic group.*

Criterion 6.2 Inventory of charcoal making technologies currently in use, assessment of their average efficiency and selection of efficient models

Indicators:

- *List of prevailing charcoal making technologies*
- *Average efficiency of common technologies assessed (record/report, fuelwood input to charcoal output ratio).*
- *List of tested efficient modals for promotion.*

Criterion 6.3 Implementation of Harvesting Plan is effective i.e. according to Tanzania Forest regulations (Government Notice No. 70 of 09/06/2006)

Indicators:

- *Charcoal production is undertaken in the approved area*
- *The trees used have been selected as provided under the district harvesting plan*
- *The charcoal is prepared in the manner provided in the harvesting plans*

Criterion 6.3 Assessment of health and the environmental impacts of common charcoal making technologies

Indicators:

- *Health related complaint and cost of medication to the charcoal makers, transporters and traders.*
- *Analysis of chemical constituents of the smoke emitted out of the chimney/exhaust pipe of charcoal kilns/pits, including green house gases (GHG) such as carbon dioxide and methane, and health damaging emissions (HDE) such as particulates and sulphur dioxide).*

Criterion 6.4 Field-testing, demonstration and extension of efficient charcoal making technology to directly relevant occupational group(s)

Indicators:

- *Different types of models tested and demonstrated in the field*
- *Selection of accepted models and efficiency*

- *Extension program for dissemination and training*
- *Continuation of R & D for further improvement*

Criterion 6.5 Guidelines for quality control of charcoal produced

Indicators:

- *Species used*
- *Particle size*
- *Packaging – type of bags, weight*
- *Labels*

CONCLUSIONS

The concept of certification is new to Tanzania. There is evidence of only one project, Kilombero Forest Limited which is striving to develop CDM (Clean Development Mechanism) the year 2000 whereby certification is one of the basic requirements in order to qualify for carbon credits. To date the goal has not been achieved, probably indicating the complexity of the process. Kilombero Forest Limited is not a woodfuel project but a timber project.

Among the woodfuel projects in chapter 7, it is only the Maseyu Eco-Charcoal, which has a clear objective of achieving certification of her future charcoal, but they also face the obvious uncertainty of market. Certified charcoal is obviously going to be expensive. In Malaysia it is estimated that the initial cost required to improve harvesting for certified timber is US$ 65.05 ha^{-1} which is equivalent to 65% of total harvesting cost without the improvement (Thang, 2001). Other sources of cost will be packaging, labelling and monitoring. The question is whether people are willing to buy the clean charcoal at the new price. This is a research area to be pursued.

On the other the tea factories obviously have some mechanism of ensuring continued supply of charcoal but it is not clear whether the systems are sustainable to meet certification requirements. It is also not known whether they would like to use certified woodfuel. Unless there is pressure from above such business enterprises would like to reduce production cost by using easily available and cheap woodfuel. Research is needed to take stock of all such woodfuel using industries and their views on certification. Otherwise mandatory certification would be possible if it were a government policy to reinforce the existing policy for sustainable forest management. In this case awareness raising and sensitization to all stakeholders especially policy makers is necessary.

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