PART II

WOOD ENERGY DATA AND METHODOLOGIES FOR URBAN AND PERI-URBAN WOOD ENERGY PLANNING

4 Wood energy data and planning tools

4.1 WOODFUEL CONSUMPTION STATISTICS

Determining current woodfuel consumption at the global, regional or national level and estimating possible future scenarios are complex tasks mainly because of the lack of adequate wood energy information in international databases and within countries themselves. This situation, common to both developed and developing countries, is a consequence of insufficient institutional awareness of the importance of wood energy for local, regional and national economies. The different “forestry” or “energy” perspectives adopted by estimating agencies, which lead to wide discrepancies in data sources, are some of the greatest problems (FAO, 2005a).

Much remains to be done in order to establish reliable wood energy statistics, but important steps have recently been taken in this direction, showing that there is hope in the future for this generally neglected sector. Significant improvements include:

- the international process promoted by FAO, leading to an established set of terms and definitions related to wood energy and bioenergy (FAO, 2004a);
- the development, in the framework of the Global Forest Products Outlook Study (GFPOS), of multivariate modelling of fuelwood and charcoal consumption based on reliable field data, used to fill in data gaps in FAO country statistics (FAO, 2001a);
- the review of existing national and international sources of wood energy information and statistics and the creation of a consultable multisource database (FAO, 2005a).

Most existing statistics on fuelwood and charcoal consumption are limited to country totals, with some breakdown by household and other sectors but rarely by urban and rural areas.

Given the lack of systematic statistics on urban woodfuel consumption, the role and dynamics of urban wood energy are inferred from the time series and projections of charcoal consumption, with the assumption that charcoal is consumed prevalently in urban contexts while fuelwood is consumed prevalently in rural ones.

4.2 GFPOS FUELWOOD AND CHARCOAL CONSUMPTION PROJECTIONS

In order to utilize the most complete set of statistics on past and projected fuelwood and charcoal consumption, all figures and statistics given here are derived from estimates at country level in the framework of GFPOS (FAO, 2001a), which cover the whole world from 1960 to 2030. This data set is the only one to attempt projections for all countries worldwide and, notwithstanding some limitations and approximations through lack of reliable field data, offers a consistent and realistic vision of likely wood energy scenarios.

Although other sources may be considered more reliable than GFPOS in a country by country analysis, at regional and global levels it appears to provide realistic and reliable aggregated estimates.

4.2.1 Global fuelwood and charcoal consumption scenario

Global trends in woodfuel consumption, shown in Figure 12, illustrate the marked increase of charcoal in all regions, especially Africa and Latin America, and the decrease of fuelwood, with the notable exception of Africa, where fuelwood demand is expected to increase until 2025.

In Asia and Africa the woody biomass used for charcoal production is at present a fraction of the amount used directly as fuelwood, while in Latin America charcoal is expected to equal fuelwood by 2030. In Africa the growth in charcoal demand primarily as a result of urbanization is extremely high and is expected to double by 2030.

4.2.2 African scenario

The consumption levels and expected trends of fuelwood and wood for charcoal in African subregions are shown in Figure 13. Charcoal consumption levels and trends are highest in tropical subregions: East Sahelian, West Moist, Tropical southern and Central Africa.

The increasing importance of charcoal consumption in tropical Africa as compared with that of fuelwood is shown in Figure 14. According to GFPOS estimates, wood used for charcoal in 2030 will correspond to half the wood used for fuelwood, with an increment of some 111 percent since 2000, compared with the 27 percent increment expected for fuelwood. In 2030 the wood used for charcoal will represent one third of the total wood used for energy.

What is most relevant, however, is that this will come almost exclusively from forests and dense woodlands and via commercial means and channels, while the majority of fuelwood will come from farmlands, agricultural and forestry residues and by-products, deadwood collection and via informal and non-commercial channels. The impact of charcoal production on forest resources is significant today but is likely to increase in the future.

It is imperative to recognize the dominant role and inherent challenges of charcoal production in forest management and to convert potential threats into development opportunities for decentralized and peri-urban communities.

FIGURE 12
Global fuelwood and charcoal consumption by region, 1970–2030 (FAO, 2001a)

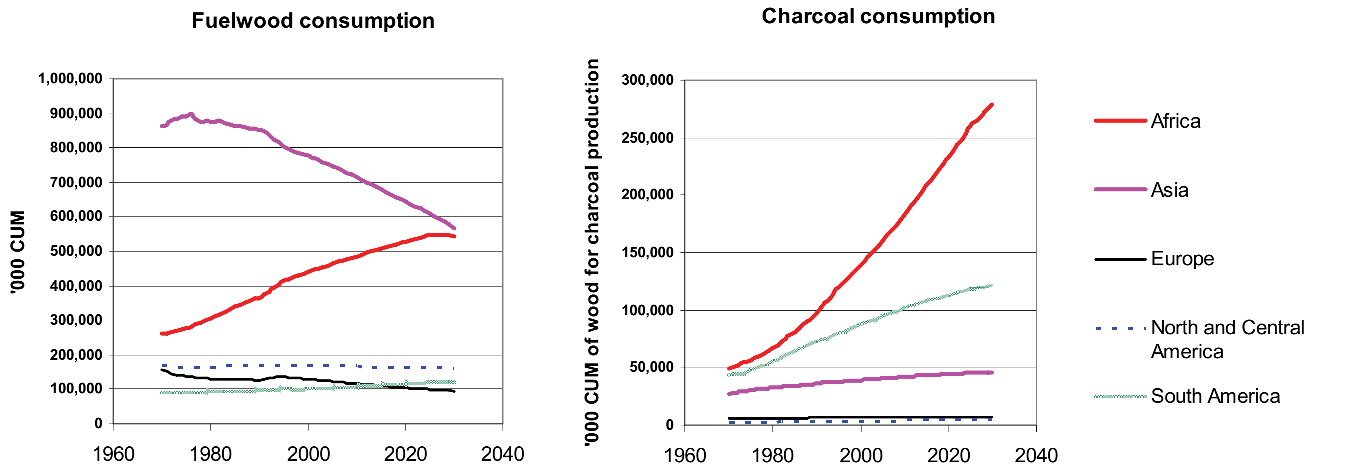


FIGURE 13
African fuelwood and charcoal consumption by subregion, 1970–2030 (FAO, 2001a)

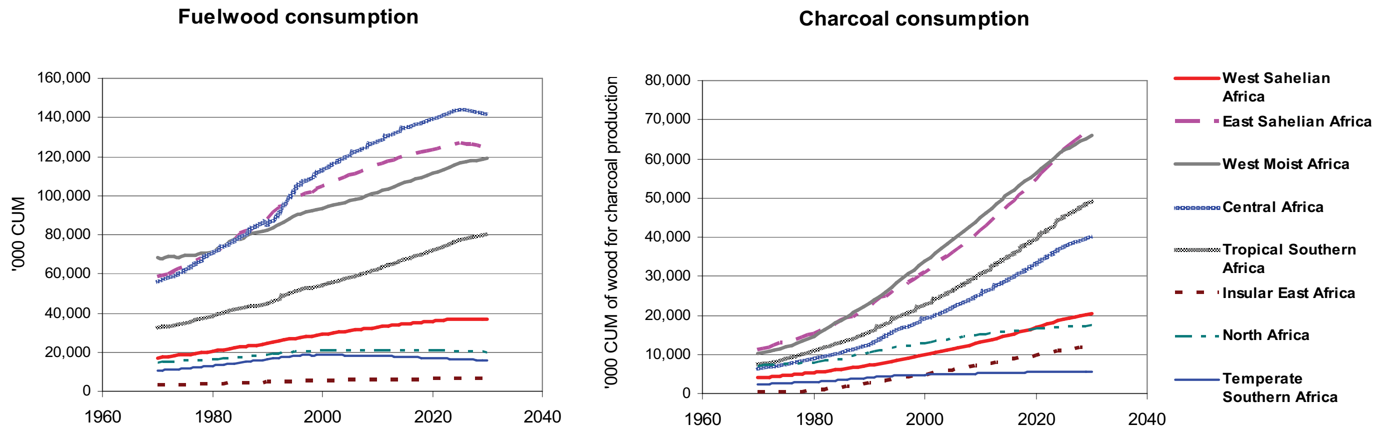
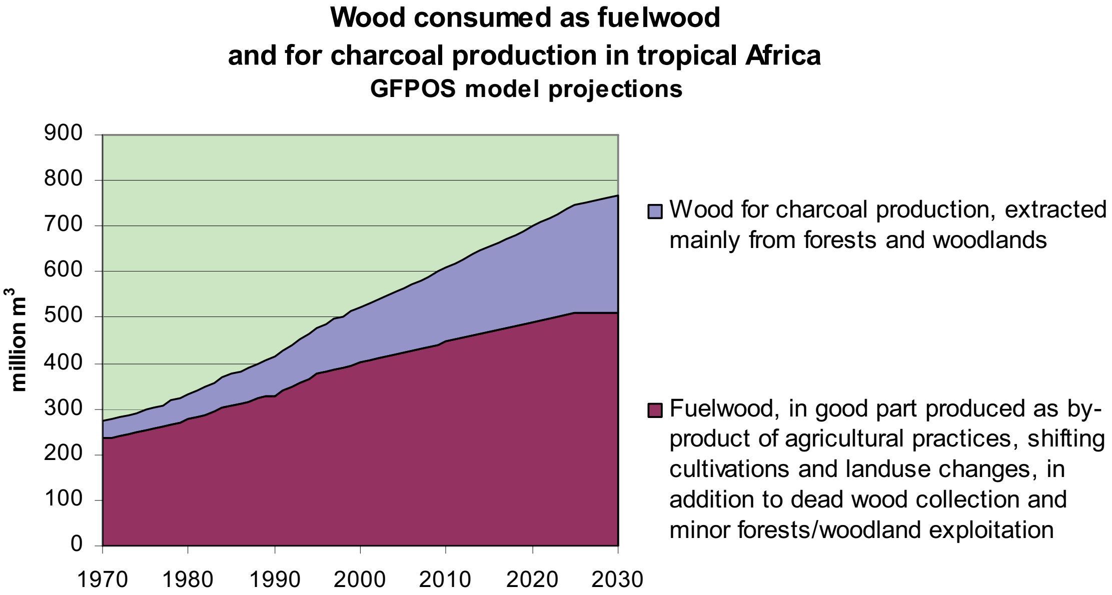


FIGURE 14
Consumption of wood for energy in tropical Africa, 1970–2030 (FAO, 2001a)



4.3 PLANNING TOOLS FOR POLICY-MAKERS

Urban wood energy is not a self-contained and delimited sector and does not have a well-defined institutional structure responsible for planning and controlling it. It rather sits at the intersection of many different sectors, disciplines and institutional competences, each of which has its specific set of responsibilities and planning tools but none of which takes direct responsibility for the development and monitoring of sustainable wood energy systems for cities. Table 5 provides a synthetic overview of the main sectors that contribute to sustainable urban wood energy planning.

A critical challenge in urban wood energy planning is to overcome the fragmentation of competences and responsibilities that characterize the sector and to achieve an adequate level of integration and collaboration among the sectors involved.

In the energy sector there are several planning tools that include wood energy elements, such as the Long-range Energy Alternatives Planning (LEAP) system (FAO, 1998a; SEI, 2000), but these are analysed mainly from the consumption perspective, omitting most of the issues related to woodfuel supply sources and production sustainability.

Forest management tools, on the other hand, deal with production sustainability (FAO, 2002b), but focus mainly on timber concessions and industrial roundwood production rather than woodfuel production, in spite of the paramount importance of woodfuels among forest products. Moreover, forest management is limited to forest formations, while a significant part of all consumed woodfuels is produced outside forests and other wooded lands (i.e. shifting cultivation areas, land use conversions, agroforestry, farmlands, etc.) or from harvesting and industrial forestry residues.

Specific wood energy problems are commonly dealt with by means of detailed local studies, such as the area-based woodfuel flow analysis (FAO, 1997a; 1998b; 2000; 2001b), where results support local planning or are expanded at national level to guide energy action and interventions. Many local studies and projects, if not most, were focused on specific cities and on their fuelwood and charcoal supply zones, with the specific scope of supporting sustainable resource management and the continued supply of woodfuels (Bertrand, Konandji and Madon, 1990; ESMAP, 1993; Chaposa, 1999).

Although these studies give adequate information and effectively support the formulation of sound policies, they are expensive and time consuming. Their cost makes them limited in coverage and sporadic, thus failing to provide the necessary national overview for the formulation of policies in respect of renewable energy potential, forestry and energy planning, inventories of greenhouse gases, and so on.

Moreover, these studies confirmed the local heterogeneity of wood energy situations and helped to specify the fundamental characteristics of wood energy systems, which may be summarized as follows.

Geographic specificity. The patterns of woodfuel production and consumption, and their associated social, economic and environmental impacts, are site specific (Mahapatra and Mitchell, 1999; FAO/RWEDP, 1997; FAO, 2003a). Broad generalizations about the woodfuel situation and impacts across regions, or even within the same country, have often resulted in misleading conclusions, poor planning and ineffective implementation.

Heterogeneity of woodfuel supply sources. Forests are not the sole sources of woody biomass used for energy. Other natural or domesticated landscapes, such as shrublands, farmlands, orchards and agricultural plantations, agroforestry, tree lines and hedges, contribute substantially to fuelwood and, to a lesser extent, to row material for charcoal production.

User adaptability. Demand and supply patterns influence each other and tend to adapt to varying resource availability, which means that quantitative estimates of the impact that a given demand pattern has on the environment are very uncertain and should be avoided (Leach and Mearns, 1988; Arnold *et al*., 2003).

TABLE 5
Sectors involved in sustainable urban wood energy planning

Sector	Main perceived focus by sector management	Potential role of the sector in urban wood energy planning
Urban forestry	Multipurpose management of urban forests, trees and green recreational areas	Promotion of suitable woodfuel species, biomass production practices and participatory management approaches in urban and peri-urban areas; bridging forestry and urban development
General forestry	Conservation of forest resources and sustainable forest management (prevalently oriented towards timber products and industrial forestry)	Participatory sustainable management of forests and woodlands for fuelwood and charcoal production within the urban woodshed; bridging rural and urban development
Urban development	Development of residential, commercial/industrial areas and infrastructure	Inclusion of woody biomass production function in land management of urban and peri-urban areas; optimization of tree cover
Urban energy	Expansion of electricity grid and gas distribution network in urban and peri-urban areas	Analysis of woodfuel demand by urban and peri-urban dwellers and its evolution over time; establishment of supply agreements with rural/forest communities
General energy	National energy policy oriented mainly towards oil-derived products, electricity and “modern” renewables	Surveying of woodfuel consumption patterns and trends; promotion of efficient energy technologies
Agriculture	Food production	Bioenergy crops, woody biomass production through woodlots of fast growing species; charcoal production to complement farmers’ income
Rural development	Sustainable development; rural communities; farmers’ associations; governance and equity; gender; poverty alleviation	Development of rural markets for woodfuels; recognition of communal rights; promotion of fuelwood and charcoal producers’ associations

Given the multisectoral and geographic character of urban wood energy, the first planning phase should therefore integrate data from different sectors and provide a comprehensive overview of the main issues, risks and opportunities from an open and spatially discrete perspective.

4.3.1 Woodfuels Integrated Supply/Demand Overview Mapping (WISDOM) methodology

In order to cover the various dimensions of wood energy systems, the FAO Forest Products Service (FOIP) has developed and implemented the WISDOM methodology, which is a spatially explicit planning tool for highlighting and determining woodfuel priority areas or woodfuel hot spots (FAO, 2003b). WISDOM is the fruit of collaboration between the FAO Wood Energy Programme and the Institute of Ecology of the National University of Mexico. At the national level, the WISDOM approach has been implemented in Mexico (FAO, 2005e; Masera *et al*., 2006), Slovenia (FAO, 2006a) and Senegal (FAO, 2004b). At subregional level, WISDOM has been implemented over the eastern and central African countries covered by the Africover Programme[5] (FAO, 2006b) and the countries of Southeast Asia[6] (FAO, in press).

The WISDOM methodology was preferred to other approaches, such as the LEAP model (FAO, 1998a; SEI, 2000), for its thematic specificity (woodfuels rather than generic energy or forestry planning) and for its open framework (i.e. not a package), which allows a high degree of flexibility and adaptability in the heterogeneity and fragmentation of data related to the production and consumption of woodfuels. With respect to the definition of urban supply zones generally applied in field projects (Bertrand, Konandji and Madon, 1990; ESMAP, 1993; CHAPOSA, 1999), the WISDOM approach has the advantage of considering the entire demand and supply context, including consumption in peri-urban and rural areas, which supports a consistent and possibly a more objective definition of urban woodsheds.

WISDOM, especially when applied at the regional level, does not replace a detailed national biomass demand/supply balance analysis for operational planning, but rather it is oriented towards supporting a higher level of planning, i.e. strategic planning and policy formulation, through the integration and analysis of existing demand- and supply-related information and indicators. More than absolute and quantitative data, WISDOM is meant to provide relative or qualitative valuations, such as risk zoning or criticality ranking, highlighting, in the highest possible spatial detail, areas deserving urgent attention and, if needed, additional data collection. In other words, WISDOM serves as an assessing and strategic planning tool to identify sites for priority action.

Baseline WISDOM analysis. The application of the standard WISDOM analysis producing baseline mapping of supply/demand balance assessed at the local level involves five main steps (FAO, 2003b).

1. Definition of the minimum administrative *spatial* unit of analysis

2. Development of the *demand* module

3. Development of the *supply* module

4. Development of the *integration* module

5. Selection of the *priority* areas or “woodfuel hot spots” under different scenarios

Additional urban woodshed module. Further focusing of analysis for the delineation of urban woodsheds, i.e. supply zones of specific urban and peri-urban areas, requires additional analytical steps that may be summarized as follows.

6. Mapping of potential “commercial” woodfuel supplies suitable for urban and peri-urban markets

7. Definition of urban woodsheds, or potential sustainable supply zones, based on woodfuel production potential and physical accessibility parameters

Figure 15 gives an overview of the main steps in the WISDOM methodology. After a countrywide analysis that is essential for defining broad issues and priority urban woodsheds with objectivity, WISDOM can be further refined in selected priority areas by using specific woodfuel flow data and thence developed into an operational planning tool, as discussed in greater detail in Chapter 5.

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[5] Burundi, Democratic Republic of the Congo, Egypt, Eritrea, Kenya, Rwanda, Somalia, the Sudan, United Republic of Tanzania and Uganda.

[6] Cambodia, Malaysia, Lao People’s Democratic Republic, Thailand, Viet Nam and China, Yunnan Province.

FIGURE 15
WISDOM analytical steps with the additional urban woodshed component (grey frame)