

National Statistics Related to Woodfuel and International recommendations

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**National Statistics Related to
Woodfuel
And international
reccomendations**

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Acronyms and Abbreviations

AFREC	African Energy Commission
CDM	Clean Development Mechanism
CIFOR/PEN	Center for International Forestry Research-Poverty and Environment Network
CWIQ	World Bank Core Welfare Indicators Questionnaire Survey
DHS	Demographic and Health Surveys
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FIP	Forest Investment Program
fNRB	fraction of Non-Renewable Biomass
GHO	Global Health Observatory
HH	Household
IEA	International Energy Agency
IHSN	International Household Survey Network
IMF	International Monetary Found
LSMS	Living Standards Measurement Study
MICS	Multiple Indicator Cluster Survey
NSO	National Statistics Office
OLADE	Latin American Energy
PRA	Participatory Rural Appraisal
SDGs	Sustainable Development Goals
UNECE	Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund
UNSD	Organization United Nations Statistics Division
USAID	United States Agency for International Development
VCS	Voluntary Carbon Standard
WB	World Bank
WHO	World Health Organization
WHS	World Health Survey

Introduction

Woodfuel¹ is used widely in developing countries for cooking and heating. Its use has implications for natural resource management, energy access, climate change, public health, labour productivity and enterprise development. However, the collection of statistics on woodfuel production and consumption has rarely received sufficient attention. Fuelwood and charcoal are produced on a small scale and are of relatively low per unit economic value. They are not generally marketed formally, and their recorded contribution to Gross Domestic Product (GDP) is therefore limited. Household production and use of traditional fuels is also associated with negative health impacts, especially for women and children. Additionally, the collection, production and transportation of fuelwood and charcoal is often arduous and may prevent allocation of time to higher-value pursuits. These causes and effects have confined the use of woodfuel to the poorer segments of society, in lieu of access to more convenient sources of energy. They also underlie the absence of mainstream economic interest in woodfuel and in the collection of related statistics.

Following the oil crisis of 1973, woodfuel use in developing countries gained significant international attention due to perceived impending fuelwood shortages resulting from huge and rising aggregate demand (Eckholm, 1975). The socioeconomic dimensions of the forthcoming “fuelwood crisis” were given specific attention. However, there were also environmental implications – in particular, rising demand for fuelwood from growing populations would lead to widespread degradation and clearance of forests (de Montalambert & Clement, 1983). These various dimensions prompted a surge in interest in woodfuels throughout the 1980s, with the mobilization of a wide range of programmes to address foreseen shortages, including tree planting in particular (Arnold et al., 2003). The calculations upon which the crisis was founded were, however, faulty and failed to account for fuel switching with income growth or collection of fuelwood from outside designated forest areas, which formed the basis of supply estimates. As such, the crises forecast did not occur. In addition,

¹ The term “woodfuel” is used to cover fuelwood and charcoal, but not black liquor, wood for direct combustion to produce electricity or pyrolysis gases, pellets, ethanol or methanol, etc. produced from wood. See FAO (2002a), available at: <http://www.fao.org/docrep/005/Y3779E/y3779e00.htm#TopOfPage>.

most attempts to ameliorate the predicted supply-demand imbalances were not successful in any case (Arnold et al., 2003; Bailis & Hyman, 2011).

With the advances in socioeconomic development around the world, the tacit assumption subsequently arose that traditional sources of energy – including fuelwood and charcoal – were heading for extinction, and that substitution with modern fuels was a foregone and welcome conclusion. Although well over two billion people (primarily in developing countries) continued to use woodfuel as their primary source of household energy, this assumption undoubtedly reduced interest in collection of statistics on woodfuel production and consumption (FAO, 2014). The promotion of sustainable woodfuel use, through efforts to ensure continued wood supply and encourage adoption of improved cookstoves, also received less attention (Arnold et al., 2003).

Against this background, the Food and Agriculture Organization of the United Nations (FAO) has been collecting and publishing national statistics on the production and trade of wood products, including woodfuel and charcoal², since 1947. In the many cases where countries do not submit figures in response to the annual questionnaires, estimates of woodfuel production are used. Prior to 2001, these default estimates were calculated by multiplying per capita demand figures by the population. The assumptions underlying the method of calculation had much in common with those upon which the fuelwood crisis was founded, and resulted in ever-increasing levels of woodfuel production and consumption as the population grew³.

In the late 1990s, growing concerns over climate change and an increasing interest in the potential role of forestry raised the likelihood that FAO forest products statistics would become a focus of attention in estimating forestry sector greenhouse gas emissions (GHG). The huge volumes of woodfuel consumed around the world and the large proportion of global roundwood production accounted for by woodfuel multiplied the potentially adverse impact of inaccurate figures on national- and international-level policy processes. FAO therefore made efforts to improve the methodology used for estimating default woodfuel consumption figures. As a result, a set of regression models was developed based on woodfuel consumption figures from surveys and national consumption estimates submitted by countries to FAO. Most importantly, the modelled consumption estimates were calculated using a range of explanatory

² The FAO country questionnaires and resulting statistics presented on FAOSTAT include woodfuel and charcoal separately, even though charcoal is a component of woodfuel.

³ As woodfuels are seldom imported or exported, production and consumption are often assumed to be equivalent.

variables encompassing income, forest area, urban proportion of the population, land area, temperature and oil production (Broadhead, Bahdon & Whiteman, 2001). In line with the findings of individual surveys on fuel switching with income growth, the models suggested that woodfuel consumption in developing countries is generally either falling in absolute terms, or falling on a per capita basis.

While the revised woodfuel production estimates are undoubtedly more accurate than those previously published, the easing trends and absence of an impending crisis did little to encourage greater global interest in fuelwood and charcoal use. Indeed, the following years saw a continuing decline in woodfuel-related programmatic activity, and forestry departments also became less active in the area. Collection of national woodfuel-related information in developing countries largely became the confine of energy agencies interested in patterns of energy consumption; labour organizations concerned with time spent collecting and producing woodfuel and associated working conditions; and national statistics agencies aiming to collect health- and energy-related information through population and housing censuses. Questions such as whether households use fuelwood or charcoal have generally been the focus, while information on amounts consumed, sources, legality and other forest-related aspects have not been collected.

In more recent years, fuelwood and charcoal consumption has, as expected, received increasing interest in relation to climate change mitigation. National-level UNFCCC-related REDD+⁴ programmes have frequently included woodfuel-related interventions, as outlined in Box 1. Associated efforts to outline methods for inclusion of woodfuel in national REDD+ programs have also been made (e.g. Democratic Republic of the Congo and Burkina Faso: Schure et al., 2014). Additionally, forest carbon projects have developed methodologies for estimation of baseline emission from forest degradation caused by extraction of woodfuel⁵. Significant attention has also come from clean cookstove programmes aiming to improve public health, reduce emissions and generate revenues from the sale of carbon credits (Griehop, Marshall, & Kandlikar 2011; Parker et al., 2015). In many cases, emissions calculations have been derived from stock woodfuel consumption estimates and default fractions of non-renewable biomass (fNRB) based on broad and untested

⁴ Reducing Emissions from Deforestation and forest Degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries.

⁵ Approved VCS Module VMD0008: Estimation of baseline emission from forest degradation caused by extraction of wood for fuel. Available at <http://www.v-c-s.org/sites/v-c-s.org/files/VMD0008%20BL-DFW%20Fuelwood%20baseline.pdf>. See also Annex 7 below.

assumptions. The efficiency of related interventions in reducing emissions from deforestation and degradation is therefore unclear. According to FAO (2010), “the calculation of CO₂ emissions and greenhouse gas impacts associated with bioenergy is plagued by a number of uncertainties, most of which are poorly addressed in current accounting methods” (p. 29).

Box 1. Woodfuel-related efforts in national REDD+ strategies

Of 31 Readiness Preparation Plans (R-PPs) under the Forest Carbon Partnership Facility (FCPF) Readiness Fund, over half include woodfuel interventions and cookstoves; a further four promote alternatives to woodfuel (Kissinger, Herold & De Sy, 2012). Examples include:

- **Ethiopia:** Adopting efficient fuelwood stoves.
- **Cameroon:** Developing biogas production to generate electricity.
- **Kenya:** Assisting implementation of legislation on charcoal production and transportation.
- **Uganda:** Tree planting and establishment of woodlots by farmers, government institutions and commercial users such as tea producers.
- **United Republic of Tanzania:** Accelerating participatory land use planning and establishing village firewood or charcoal production areas.

Under the World Bank’s Forest Investment Program (FIP) four of eight countries include reduced woodfuel use and/or sustainable woodfuel production in their proposed investment plans. Activities include:

- **Mexico:** Encouraging use of local wood lots, collecting sustainable fuelwood and logging debris in production forests, and formalizing commercial fuelwood collection and trade.
- **Democratic Republic of the Congo:** Distributing improved cookstoves and training communities in charcoal-making.
- **Ghana:** Promoting sustainable woodfuel production.
- **Burkina Faso:** Addressing drivers of deforestation and degradation, including woodfuel and charcoal production.

Under the FCPF Carbon Fund, six of eleven accepted country proposals include woodfuel demand as a main driver of forest degradation, and propose different solutions:

- **Congo:** Distributing and promoting cookstoves in urban centres;
- **Viet Nam:** Providing renewable energy solutions, including biogas and waste-to-energy;
- **Nepal:** Installing biogas plants to reduce woodfuel demand;
- **Democratic Republic of the Congo:** Implementing an Eco-Charcoal Program to sustainably produce charcoal from plantations and degraded forest to substitute for “bush” charcoal;
- **Chile:** Promoting use of official woodfuel processing centres and developing competitiveness and legality in the forestry products value chain;
- **Guatemala:** Updating forest inspection systems and reducing illegal woodfuel production.

Source: based on Parker et al. (2015).

More broadly, and despite falling per capita consumption and the absence of any previously unforeseen crisis, the magnitude of woodfuel use in developing countries, the number of users and the potential impact of woodfuel consumption on livelihoods and the environment demand continuation of efforts to collect woodfuel consumption statistics. As experience has shown, a lack of sound statistics can allow proliferation of misguided and ineffective policy and renewed effort is necessary to avoid such possibility. Furthermore, the impact of commercial production of fuelwood and charcoal on forest resources remains varied and uncertain, and changes in household woodfuel consumption trends resulting from economic downturns or fossil fuel price fluctuations cannot be excluded. It has also been suggested that, in some areas, a switch to modern fuels may take time, and that a focus on substitution could be counterproductive in increasing access to sustainable fuels and improving management of forest resources, because the demand for woodfuel will persist (Maes & Verbist, 2012; Zulu, 2010). It should also be considered that, if used with appropriate equipment and in accordance with the principles of sustainability, woodfuel may provide economic, social and environmental benefits; further, it may present opportunities for enterprise development and income generation, while also reducing fossil fuel consumption.

In this context, the Sustainable Development Goals (SDGs)⁶ call for action in a number of areas that are potentially relevant to woodfuel consumption and production:

- SDG 3: Ensure healthy lives and promote well-being for all at all ages;
- SDG 5: Achieve gender equality and empower all women and girls;
- SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all;
- SDG 12: Ensure sustainable consumption and production patterns;
- SDG 13: Take urgent action to combat climate change and its impacts;
- SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Goals 7, 13 and 15 are perhaps most directly relevant to woodfuel use, although their impact on consumption patterns will depend on the extent to which woodfuel can be used sustainably and on the availability and sustainability of

⁶ More information on the United Nations SDGs is available at <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>.

alternatives. As such, woodfuel has the potential to play a role in sustainable development, and may be far from becoming extinct as an energy source.

For the many reasons outlined above, improved woodfuel consumption statistics are essential. Improved statistics will benefit the poorer segments of society in developing countries by facilitating the development of policies and programmes aimed at improving access to sustainable energy sources and sustainable natural resource management. Benefits to the international community through GHG emissions reduction may also be possible; in addition, given the recent galvanizing of the global responses to climate change by the agreement reached at the COP 21 in Paris, significant increases in international financing for climate change are expected in coming years. In programming this funding, accurate statistics will be invaluable.

Improving woodfuel consumption statistics is, however, not a simple task; woodfuel consumption surveys are expensive and accurate results are difficult to achieve (Openshaw, 1979). Often, the countries most dependent on woodfuel are also among the poorest, and have limited resources available for collecting such information. In this context, including woodfuel-related questions in existing national household surveys offers advantages in terms of costs and the breadth and representativeness of the sampling frameworks employed. National household surveys that have included questions on primary fuel use could also serve as sampling frameworks in estimating the quantities of woodfuel consumed at the national level, through subsequent rapid assessments.

As well as providing information of direct interest at national and subnational levels, surveys can provide invaluable information on the evolving relationships between variables such as woodfuel consumption, conversion technologies used, urbanization, availability of forest resources and other supply sources, and income. Such information, collected in surveys carried out across a number of countries, could be used to estimate regional and global patterns of woodfuel consumption with much greater accuracy than is possible with currently available data.

This Technical Report constitutes an initial step of a project that aims to enhance national statistics on woodfuel production and consumption in developing countries by creating and testing a tool to integrate a woodfuel module into national household surveys. The project focuses on the informal production and consumption of woodfuel, i.e. household and small-scale enterprises and producing units.

The Review is structured as follows: after this introduction and a statement of the objectives, Section 3 summarizes the many different data collection

initiatives, censuses and surveys that focus partially or entirely on woodfuel use; the section includes a description of larger surveys, along with the questions included and the woodfuel information currently available from past survey iterations. Small-scale surveys described in journal articles, proceedings, project reports and other literature are not comprehensively reviewed, owing to the scale of the task involved; instead, a broad selection of different survey types and their contents are examined. Drawing on information summarized in Section 3, Section 4 outlines potential next steps in improving woodfuel production and consumption statistics in developing countries, by making use of existing data and developing a woodfuel module for inclusion in household surveys or to be used as a stand-alone survey tool. At the end, a set of Annexes is available.

Finally, it is important to note that this document was produced under one of the key components of the Global Strategy to Improve Agriculture and Rural Statistics (GSARS or Global Strategy): the Research Plan, that aims to develop cost-effective methods that will serve as the basis for preparing technical guidelines, handbooks and training material to be used by consultants, country statisticians and training centres. The Research Plan includes a topic titled “National statistics related to woodfuel production and consumption in developing countries, survey-based woodfuel studies, and international recommendations on woodfuel surveys”. This document, originally prepared as a working paper, has been finalized as the first of several Technical Reports planned by this research topic in collaboration with the Forestry Policy and Resources Division (FOA) of FAO’s Forestry Department.

Objectives

Under the Global Strategy's research component, this Literature Review aims to assess the quality and availability of woodfuel statistics and associated information on the related economic, social and environmental dimensions; highlight major data gaps; and propose recommendations for improvements in view of relevant international guidance, including criteria and indicators for sustainable woodfuels. The specific objectives are to:

1. Review the literature on (i) national statistics related to woodfuel production and consumption in developing countries; and (ii) survey-based woodfuel studies;
2. Analyse the design of woodfuel surveys in relation to international recommendations.

Woodfuel Production and Consumption Statistics in Developing Countries

Woodfuel statistics are published by a wide range of entities working at different levels and covering different geographical areas. At the international level, several agencies publish annual national woodfuel, fuelwood, charcoal or solid biomass consumption figures for many countries, and have done so for several years, as detailed in Section 3.1.

Woodfuel-related data is also collected through an extensive range of internationally supported population and housing surveys and censuses, as reviewed in Section 3.2. In most cases, woodfuel consumption is not quantified; rather, the focus is on information of socioeconomic interest, such as fuel types used for household cooking, lighting and heating, expenditure on fuel, time spent collecting fuelwood, type of stove used, etc.

At the national level, household surveys conducted by energy agencies often provide more detailed information on woodfuel use and on the use of other energy sources (see Section 3.3). Smaller-scale woodfuel and energy surveys also provide systematically collected information on woodfuel consumption depending on the purpose of the survey. Generally, these are conducted at the level of individual villages, towns or regions, but may also be conducted at the national level (see Section 3.4).

3.1. International statistics collections including woodfuel data

3.1.1. Faostat

Through the FAOSTAT database, FAO publishes national figures for the production and trade of coniferous (C) and non-coniferous (NC) woodfuel and charcoal. Flags are provided to indicate the source of the figures, as shown in Table 1. Country reporting rates have fluctuated over the decades; in any case, they have always remained relatively low. For example, in 2012, woodfuel (NC) production figures were only provided by 23 percent of the 221 countries

for which any woodfuel or charcoal production or trade records exist in FAOSTAT. This compared to 21 percent for woodfuel (C) and 24 percent for charcoal. In the case of the 151 countries defined as “developing” by International Monetary Fund (IMF)⁷, the respective figures are 17 percent, 15 percent and 18 percent, as shown in Table 1.

Table 1. Percentage of FAOSTAT national woodfuel figures from different sources in developing countries, 2012.

Flag	Data source	Wood Fuel NC (%)	Wood Fuel C (%)	Charcoal (%)
F	FAO estimate	75.5	76.2	73.5
Fp	Provisional computer-calculated data	1.3	2.6	2.0
Q	Official data reported by countries on FAO questionnaires	16.6	14.6	17.9
W	Data reported on official country publications or websites, or trade country files	0.0	0.0	0.7
X	Reliable international sources (USDA, WTO, World Bank, IMF, IEA, UNSD)	2.0	1.3	0.7
-	IMF developing countries with no woodfuel-related records in FAOSTAT	4.6	5.3	5.3

In 2012, 37 developing countries reported one or more components of woodfuel production to FAO (Table 2). Only five of these were among the 29 FAO-defined Least Developed Countries (LDCs); in all of these cases, only one component was reported (Table 2).

Table 2. IMF developing countries and FAO LDCs reporting woodfuel statistics to FAO in 2012.

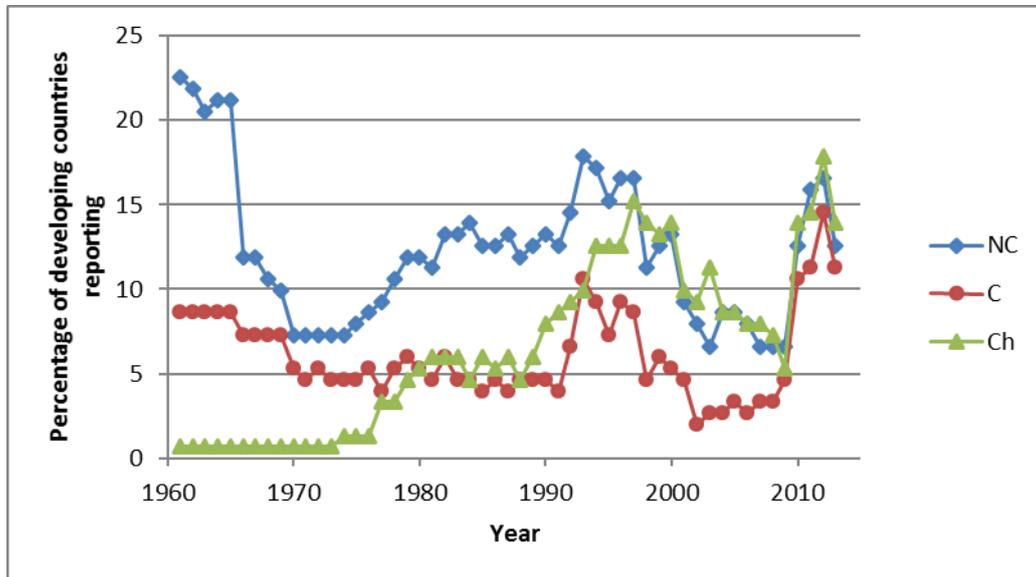
Country (LDCs in bold)	Wood Fuel NC	Wood Fuel C	Charcoal
Argentina	x	x	x
Armenia		x	x
Azerbaijan			x
Belarus	x	x	x
Bosnia and Herzegovina	x	x	x
Brazil	x	x	
Bulgaria	x	x	
Burundi	x		
Croatia	x	x	
Eritrea	x		

⁷ See the IMF World Economic Outlook 2015: <http://www.imf.org/external/pubs/ft/weo/2015/02/pdf/text.pdf>.

Georgia	x	x	
Honduras			x
Hungary	x	x	x
Iran (Islamic Republic of)	x		x
Kyrgyzstan			x
Malaysia		x	
Mali			x
Mauritius	x	x	x
Mexico			x
Mozambique			x
Peru	x		x
Philippines			x
Poland	x	x	x
Republic of Moldova		x	x
Romania	x	x	x
Russian Federation			x
Serbia	x	x	x
Sudan			x
The former Yugoslav Republic of Macedonia	x	x	x
Tunisia	x	x	x
Turkey	x	x	
Turkmenistan	x	x	x
Uganda	x		
Ukraine	x	x	x
Uruguay	x	x	
Uzbekistan	x	x	x
Viet Nam	x		x

Since 1961, trends in country reporting of woodfuel production figures to FAO have fluctuated, as shown in Figure 1. below. Increased reporting in the mid-1970s is likely to have been a response to the fuelwood crisis predicted; the increases from 2008/09 probably reflect increasing interest in woodfuel in relation to climate change.

Figure 1. Number of developing countries reporting Wood Fuel (NC), Wood Fuel (C) and Charcoal (Ch), 1961-2013



When countries do submit official data to FAO, information on their sources is often not available; therefore, their reliability cannot be assessed. The Joint Forest Sector Questionnaires through which data is collected are sent to national correspondent for forest sector statistics. Thus, the estimates may only include woodfuel derived from areas designated as forest or officially recorded woodfuel production; as such, they may underestimate actual production (FAO, 2002b).

When countries do not submit woodfuel and charcoal production figures to FAO, modelled estimates of fuelwood and charcoal consumption are used to estimate production, taking into account any submitted import and export data. The modelled consumption estimates are based on household and non-household fuelwood and charcoal consumption data from field-based surveys (see Box 2) and official national woodfuel consumption data submitted to FAO by countries (Broadhead et al., 2001). The majority of the models employ a range of explanatory variables encompassing income, forest area, urban proportion of the population, land area, temperature and oil production. Where less than 10 official woodfuel production records had been reported to FAO by any one country prior to 2000, forecasts and hindcasts were based on these figures, together with income and/or population data. Coniferous/non-coniferous (C/NC) proportions of woodfuel production are based on the figures submitted to FAO by countries in 1999 or, where figures were not submitted, woodfuel is assumed to be 100 percent non-coniferous for tropical countries and 100 percent coniferous for high-latitude countries.

Box 2. FAO Global Forest Products Outlook Study - Past Trends and Future Prospects for the Utilization of Wood for Energy

In 2001, FAO published a compendium of information on woodfuel consumption, gathered through a wide-ranging literature search (Bahdon et al., 2001). The report contains woodfuel consumption data and associated information from surveys undertaken in 239 locations across 66 countries, and published between 1965 and 1996. Almost all the data is from developing countries and comprises household, industrial and commercial consumption of fuelwood and charcoal, together with data on supply source, socioeconomic information and local price and income data where available. The 459 data records collected were used in parameterizing the models used to estimate fuelwood and charcoal consumption for all countries between 1961 and 2030. These estimates are included in FAOSTAT when countries do not submit woodfuel production figures to FAO.

In relation to household woodfuel and charcoal consumption in developing countries, FAOSTAT data have advantages and disadvantages. Advantages include:

- Broad country coverage and long time series availability (1961-present and projections up to 2030);
- Data are either official or, to the extent possible, estimated on the basis of official data and actual measurement of woodfuel consumption retrievable from surveys, as outlined above and detailed in Broadhead et al. (2001).

Disadvantages include the following:

- The official data, which directly account for a proportion of all woodfuel consumption data and contribute significantly to FAO estimates, are derived from unknown sources.
- FAO estimates make extensive use of survey-based data and are therefore subject to sample selection bias.
- FAOSTAT figures represent total national production/consumption, including both household and non-household consumption⁸.
- FAO estimates use both cross-sectional and time series data for extrapolation, with unknown effects on reliability.
- FAO estimates are extrapolated on the basis of GDP, population and forest area figures available in 1998; actual figures are likely to have diverged considerably since then, especially those for GDP.

⁸ Segregated household and non-household consumption figures are, however, available (see Broadhead et al., 2001).

- FAO estimates for charcoal and non-household fuelwood consumption are unlikely to be highly accurate, owing to the paucity of data on which the models were based.

Despite this long list of disadvantages, the FAOSTAT figures still constitute the most complete, best-documented and probably most reliable global data sets on woodfuel consumption.

3.1.2. The international energy agency (IEA)

The IEA publishes national aggregate production and consumption figures on renewables and waste, including solid biofuels and charcoal, for 34 OECD⁹ countries and 108 non-OECD countries and territories. Data for most countries is available back to 1990. Figures are provided on an annual basis in terajoules for the following:

1. Production of solid biofuels (excluding charcoal) including: (i) Fuelwood, wood residues and by-products; (ii) Wood pellets; (iii) Black liquor; (iv) Bagasse; (v) Animal waste; and (vi) Other vegetal materials and residues.
2. Consumption of solid biofuels and of charcoal by different sectors: Industry, Transport Commercial and public services; Residential; Agriculture/Forestry; Fishing; Not elsewhere specified (Other).

Country administrations submit figures via IEA/OECD-Eurostat-UNECE¹⁰ joint questionnaires¹¹. For developing countries, little information is available on surveys or estimation techniques (IEA, pers. comm., 4 December 2015). When data are not received, estimates are drawn from various sources, including FAO, the African Energy Commission (AFREC) and Latin American Energy Organization (OLADE)¹².

In relation to household woodfuel production and consumption in developing countries, the IEA figures are of limited use. Annual national solid biofuel and charcoal consumption figures for the residential sector are available only in terajoules, and are based on unknown estimation procedures. The “Solid

⁹ Organisation for Economic Co-operation and Development.

¹⁰ United Nations Economic Commission for Europe.

¹¹ See: <http://www.iea.org/statistics/resources/questionnaires/annual/>

¹² OLADE estimates of national residential wood consumption for cooking are based on standard wood consumption figures per person per meal, adjusted according to the number of wood-consuming households, household size, whether wood is the only cooking fuel or a primary or secondary fuel, and the number of urban and rural households (IEA, pers. comm., 15 January 2016).

biofuels” category also includes items that are not of direct interest in relation to household woodfuel use: wood pellets, black liquor, bagasse, animal waste and other vegetal materials and residues.

3.1.3. The United Nations Statistics Division (UNSD)

The UNSD Energy Statistics Database contains data on annual household fuelwood and charcoal consumption in the *biomass and waste* category. Fuelwood consumption data are reported in cubic metres and are available for 210 countries. Charcoal consumption data are reported in metric tonnes and are available for 179 countries. Data are available online back to 1990; fuelwood and charcoal data from before 1990 may be available in the full database.

Data are either derived from IEA figures¹³, submitted by national statistics offices or ministries of energy or environment through the UNSD Annual Questionnaire on Energy Statistics¹⁴, drawn from country publications, estimated by UNSD based on previous firm data from the country, or based on FAO data but referred to as estimates (UNSD, pers. comm., 30 December 2015).

A rapid assessment of all household fuelwood consumption records since 1990 contained in the Energy Statistics Database¹⁵ showed that 67 percent are estimates and around 45 percent of these are equivalent to the total national fuelwood consumption figures published in FAOSTAT. Overall, approximately one third of all fuelwood consumption records appear equivalent to FAO data, despite the difference in quantity (household vs total national consumption). With respect to household charcoal consumption data since 1990, 51 percent are estimates, and most of these are equivalent to the total national charcoal production figures published in FAOSTAT. In total, approximately 50 percent of the “household” charcoal consumption figures coincide with FAO total national charcoal production figures.

The only household fuelwood and charcoal consumption data in the Energy Statistics Database that are potentially based on original sources appear to be those submitted by national agencies. However, these figures may also be from

¹³ The IEA provides the UNSD with information on the production of individual products contained under the “Solid biofuels” heading, which the UNSD then allocates to transformation and consumption. For example, a proportion of “Fuelwood, wood residues and by-products” will be allocated to residential consumption (UNSD, pers. comm., 31 December 2015).

¹⁴ The UNSD’s Annual Questionnaire on Energy Statistics is available at <http://unstats.un.org/unsd/energy/quest.htm>.

¹⁵ The UNSD Energy Statistics Database fuelwood data are available at <http://data.un.org/Data.aspx?d=EDATA&f=cmID%3aFW%3btrID%3a1231>.

undocumented sources; therefore, it may be best to avoid using records in the database unless sound information validating the source can be found.

3.1.4. Other sources

In addition to the sources outlined above, Drigo (2005) lists the following woodfuel data sources of potential relevance to household fuelwood and charcoal consumption in developing countries:

Country reports from the FAO/EC Partnership Programme on Sustainable Forest Management

These are thematic studies on wood energy statistics covering 39 countries carried out within the framework of the FAO/EC Partnership Programme on Sustainable Forest Management (2000–2002). The country studies provide short time series based on information from national and local surveys, and other material.

ENDA/IEPE

In 1995, the Environmental Development Action in the Third World (ENDA), Senegal and the *Institut d'Économie et de Politique de l'Énergie* (IEPE), France published a study on the energy situation in 28 French-speaking African countries. This study included national-level data, but not time series.

The UNECE/FAO Forestry and Timber Section Joint Wood Energy Enquiry¹⁶

The Joint Wood Energy Enquiry is implemented in UNECE countries and collates national-level information on wood energy through a biennial questionnaire. The enquiry collects disaggregated data on the supply and use of wood energy, and does not require official data. As such, official data on wood energy is critically assessed and complemented with empirical data from studies, science and the industry. Expert estimates may also be included.

¹⁶ The UNECE/FAO Joint Wood Energy Enquiry is available at <http://www.unece.org/forests/jwee.html>.

ESMAP

The World Bank Energy Sector Management Assistance Program (ESMAP) conducted numerous projects in the 1970s and 1980s, covering 39 African countries. Project documents contained original data and information on woodfuels.

The RWEDP¹⁷

In Asia, FAO implemented the Regional Wood Energy Development Programme (RWEDP) to strengthen wood energy-related assessment and planning in 16 developing countries in South and South-East Asia. National-level data were produced prior to 1997.

Selected data from ESMAP and the RWEDP are included in the FAO Global Forest Products Outlook Study (Bahdon et al., 2001; see also Box 2).

¹⁷ For more information on the RWEDP, see <http://wgbis.ces.iisc.ernet.in/energy/HC270799/RWEDP/public.html>.

3.2. National household survey statistics including woodfuel-related data

Nationally-led population and housing censuses in developing countries frequently contain questions on household fuel sources. For example:

- The 2011 Botswana Population and Housing Census covered every household in the country and included questions on the principal energy sources used for household lighting, cooking and space heating¹⁸.
- The Ghana 2010 population and housing census¹⁹ included questions on main fuels used for lighting and cooking, including fuelwood and charcoal (GSS, 2013).
- The India Census 2011 collected information on households by type of fuel used for cooking (Firewood, Crop residue, Cowdung cake, Coal, Lignite, Charcoal, Kerosene, LPG, Electricity, Biogas, Any other, No cooking).

As outlined in the subsections below, in addition to information from sources supported by international organizations, an unpublished review conducted by FAO in preparation for the 2014 edition of *The State of the World's Forests* identified 21 national censuses containing information on use of woodfuel for cooking, as shown in Table 3.

Table 3. National censuses since 2000 containing information on the use of woodfuel for cooking.

Albania (2011)	China (2010)	Nepal (2011)
Armenia (2001)	Cook Islands (2006)	Panama (2010)
Bangladesh (2011)	India (2011)	Senegal (2006)
Belize (2010)	Indonesia (2010)	Solomon Islands (2009)
Bhutan (2005)	Iran (2011)	South Africa (2007)
Bolivia (2007)	Malawi (2008)	Sudan (former) (2008)
Cambodia (2008)	Micronesia, Fed. States of (2000)	Vanuatu (2009)

As noted, several international organizations – including the World Bank (WB), various United Nations (UN) bodies and the United States Agency for International Development (USAID) – also support collection of household-level socioeconomic data in developing countries, including woodfuel-related information. These and other organizations disseminate information from the surveys that they support and, in some cases, from a wider range of household

¹⁸ The Botswana Population and Housing Census 2011 Analytical Report may be found at http://www.cso.gov.bw/images/analytical_report.pdf.

¹⁹ The Ghana 2010 population and housing census materials are available at <http://catalog.ihsn.org/index.php/catalog/3780>.

surveys and national population and housing censuses. For example, the International Household Survey Network's (IHSN) central survey catalogue and the UN Compendium of Housing Statistics provide information collected from surveys and censuses in several countries to support data sharing and coordination. The World Health Organization (WHO) Household energy database compiles information related to exposure to household air pollution from surveys conducted by the WHO and other bodies. The WHO also maintains the Global Health Observatory (GHO) data repository, which contains estimates of population using solid fuels in 194 countries.

In relation to woodfuel, many of these surveys do not extend beyond enquiries on the types of fuel used in different household applications, with the focus often limited to the primary fuel used for cooking. Some surveys also include questions on time spent gathering fuelwood and woodfuel expenditure. The United Nations Children's Fund (UNICEF) Multiple Indicator Cluster Surveys, Demographic and Health Surveys and WHO surveys include questions on cooking location and equipment used; Labour Force Surveys commonly include questions on time spent engaged in woodfuel collection/production and injuries associated with woodfuel use. Despite these general rules, many surveys contain additional information on quantities of woodfuel consumed and source.

The individual initiatives summarized above are reviewed in the following subsections, although it should be noted that overlaps in coverage between the different statistical collections exist and have not been fully resolved. It should also be noted that few of these initiatives include information on quantities of woodfuel consumed.

3.2.1. The International Household Survey Network (IHSN)

The IHSN is an informal network of international agencies that aims to improve the availability, accessibility and quality of survey data within developing countries, and to encourage the analysis and use of this data by national and international development decision makers, the research community and other stakeholders. To support these aims, the IHSN maintains a Central Survey data catalogue²⁰, which informs data users of the availability of survey and census data from multiple sources.

²⁰ IHSN Central Survey catalogue: <http://catalog.ihsn.org/index.php/catalog>.

The IHSN Central Survey catalogue provides a searchable list of surveys and censuses conducted in low- and middle-income countries. Searches of this list identified 466 surveys containing questions including the words “firewood”, “fuelwood” or “charcoal”. The surveys cover 103 low- and middle-income countries and include Living Standards Measurement Surveys, Multiple Indicator Cluster Surveys, Core Welfare Indicators Questionnaire Surveys and Labour Force Surveys (see below), as well as population and housing censuses, agricultural censuses and surveys on food security and vulnerability, disability, education, energy, income and expenditure, health and industries.

The catalogue provides the survey questionnaire(s), manuals and report(s), and a list of related citations when available. A link to external catalogues containing survey data is provided, if available.

Common woodfuel-related questions contained in identified surveys cover the following:

- Incidence of household fuelwood or charcoal use;
- Expenditure on fuelwood and/or charcoal;
- Price of firewood and/or charcoal;
- Sale of charcoal and/or charcoal;
- Cutting of firewood;
- Time spent collecting firewood;
- Location of charcoal purchase;
- Cooking fuel type used;
- Stove type used;
- Light source;
- Availability of firewood and/or charcoal.

Less frequently posed questions cover the following:

- Source of firewood;
- Production of firewood;
- Quantity of firewood and/or charcoal consumed;
- Planting of trees for firewood or charcoal production;
- Changes in firewood and charcoal availability and price, and reasons;
- Environmental problems, including deforestation;
- Change in distance to source of firewood.

Countries with richer collections of woodfuel-related information referred to in the IHSN catalogue include the following:

- Bangladesh
- Cambodia
- Ethiopia
- Ghana
- India
- Indonesia
- Kenya
- Malawi
- Mongolia
- Nepal
- Nigeria
- Pakistan
- Philippines
- South Africa
- Sri Lanka
- Uganda
- Zambia

3.2.2. The UN compendium of housing statistics

The UNSD collects official national statistics on housing stock and housing conditions generated from population and housing censuses²¹. In 2005, the UNSD initiated a systematic and regular collection of basic statistics on housing by introducing a housing statistics questionnaire. Earlier data collections were conducted in 1992 and 1999, in collaboration with the United Nations Human Settlements Programme (UN-HABITAT).

The 2011 Compendium of Housing Statistics includes a table on the “Occupied housing units by type of housing unit, main type of fuel used for cooking and urban/rural location: latest available year, 1995 – 2010”, which covers 35 countries²². The information is drawn from censuses detailed in the UNdata retrieval system²³.

²¹ For the UNSD demographic and social statistics on housing, see <http://unstats.un.org/unsd/demographic/sconcerns/housing/default.htm>.

²² The Compendium of Housing Statistics 2011 may be consulted at <http://unstats.un.org/unsd/demographic/sconcerns/housing/chs2011.htm>.

²³ The UNdata system is available at <http://data.un.org/Data.aspx?d=POP&f=tableCode%3a293>.

Table 4. Countries for which information on main household fuel type is available through the 2011 Compendium of Housing Statistics.

Algeria: 2008 (no firewood or charcoal)	Mauritius: 2000
Antigua and Barbuda: 2001 (no charcoal)	Mexico: 2010 (no charcoal)
Azerbaijan 2009: (no firewood or charcoal)	Montenegro: 2003 (no firewood or charcoal)
Botswana: 2001	Nicaragua: 2005 (no charcoal)
Burkina Faso: 2006	Occupied Palestinian Territory: 1997 (no charcoal)
Cambodia: 2008	Palau: 2005 (no firewood or charcoal)
Cayman Islands: 2010 (no firewood)	Peru: 2007 (no charcoal)
Chile: 2002 (no charcoal)	Republic of Moldova: 2004 (no firewood or charcoal)
Colombia: 2005 (no charcoal)	Romania: 2002 (no firewood or charcoal)
Costa Rica: 2000 (no firewood or charcoal)	South Africa: 2001 (no charcoal)
Dominican Republic: 2002	Swaziland: 2007 (no charcoal)
DPR Korea: 2008 (no charcoal)	Thailand: 2000
Ethiopia: 2007	Tokelau: 2006 (no charcoal)
Jamaica: 2001	Tonga: 2006 (no charcoal)
Kenya: 1999	Uganda: 2002
Lesotho: 2006 (no charcoal)	Uruguay: 1996 (no charcoal)
Liberia: 2008	Zimbabwe: 2002 (no charcoal)
Maldives: 2006 (no charcoal)	-

3.2.3. The Living Standards Measurement study (LSMS)

The LSMS is a household survey program conducted within the Surveys & Methods Unit of the World Bank's Development Research Group, which provides technical assistance to national statistical offices (NSOs) in designing and implementing multi-topic household surveys. Surveys containing information on household energy use are available for 37 countries, as shown in Annex 1 to this Technical Report.

Although questions from more recent surveys held in developing countries generally did not include quantities consumed, a range of woodfuel-related topics was indeed covered:

- **Brazil 1997 Survey of Living Conditions** - Cooking fuel types.
- **Burkina Faso 2014 *Enquête Multisectorielle Continue*** - Primary fuels for lighting and cooking and expenditure on fuelwood or charcoal consumed for heating.

- **Ethiopia 2013 Socioeconomic Survey** – hours spent collecting firewood; expenditure on firewood and charcoal; main source of light; main source of cooking fuel (including collected firewood, purchased firewood, charcoal); sale of firewood or charcoal.
- **Ghana 1998 Living Standards Survey** – time spent fetching wood for household use; main household cooking fuel.
- **India 1997 – Uttar Pradesh and Bihar Survey of Living Conditions** – Primary and secondary household cooking fuel; household expenditure on wood.
- **Iraq 2012 Iraq Household Socio-Economic Survey** – Primary and secondary sources of energy used for cooking, lighting, heating, cooling, warming water; sale, consumption and purchase of forest products in monetary units; household acquisition of wood for fuel.
- **Malawi 2013 Third Integrated Household Survey** – hours spent collecting fuelwood, main source of fuel for cooking and lighting, firewood collection source and time expenditure, firewood purchase and electricity access (see Annex 2 for further details).
- **Nepal 2010 Living Standards Survey** – fuel most often used for cooking; type of stove mainly used for cooking; use and collection of household firewood; how much firewood collected and time spent; source of firewood (own land, community-managed forest, government forest, other); expenditure on wood and charcoal; monetary value of firewood collected; time spent by household members collecting firewood.
- **Niger 2011 *Enquête Nationale sur les Conditions de Vie des Ménages et l’Agriculture*** – Time spent collecting firewood by household members; two main sources of cooking fuel; expenditure on firewood for heat and charcoal.
- **Nigeria 2012 GHS Panel Survey** – Time spent collecting/chopping firewood; expenditure on firewood and charcoal.
- **Papua New Guinea 1996 Household Survey** – Whether firewood gathered or sold; fuel usually used for household cooking.
- **United Republic of Tanzania 2010 National Panel Survey** – Time spent collecting firewood; major fuel for cooking; major fuel for lighting.

- **Timor-Leste 2007 Survey of Living Standards** – Fuel most often used for cooking; expenditure on firewood and other fuels; whether or not wood fetched; amount of household fuelwood production.
- **Uganda 2011 National Panel Survey** – Time spent collecting household firewood; types of stove used by household and type used most often; whether main stove has a chimney; hours per day main stove is burning; location of main stove; types of fuel used for cooking, lighting and heating and source of fuels (gathered + source and/or purchased + source) and amount paid; amount of firewood, charcoal and other fuels purchased, produced or received free and unit price; timing of and reasons for insufficiency of food to feed household, including lack of fuelwood.

In addition to information directly related to woodfuel consumption, the LSMS agriculture modules commonly contain questions on tree crops and their value, and expenditure on fuel (Jolliffe, 1995). The LSMS Integrated Surveys on Agriculture²⁴ (LSMS-ISA), developed in 2008, include questions covering tree crops on land owned or cultivated. The LSMS-ISA has been carried out in eight countries: Burkina Faso, Ethiopia, Malawi, Mali, Niger, Nigeria, Uganda and United Republic of Tanzania. Forestry modules have also been developed to be integrated into the LSMS household and community modules, as detailed in Box 3 below.

²⁴ For more information on the LSMS-ISAs, see <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:23512006~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html>.

Box 3. LSMS Forestry Modules

Bakkegaard et al. (in prep.) have developed forestry modules to be integrated into the LSMS household and community modules, to assess the forest and wild product contributions to local communities and households. The publication includes guidance for integrating the modules into LSMS surveys and options for non-LSMS users to implement the forestry modules separately. In particular, the survey modules contain the following:

- Cash and subsistence income from forest and wild products (Household module)
- Other forest-related income sources (Household module)
- Food and nutrition (Household and Community modules)
- Employment/business benefits (forest-related)
- Forest-related Assets (Household module)
- Energy (Household module)
- Health (quantities and use of medicinal plants for cash and subsistence) (Household module)
- Structural and fibre products (Household module)
- Other products from forests or trees (Household module)
- Climate change and environmental services (optional Household and Community modules)
- Extension services (Community module)
- Forest clearance (optional Household module)
- Food shortage, insurance, shocks and coping strategies (Household module)
- Governance (optional Community module)

Woodfuel-related information is covered primarily by Core Household Module A: Income and Core Household Module C: Forest resources – energy, health and construction (see Annex 2 to this Technical Report). The modules aim to answer questions such as:

- How important is the role of wood energy in household use, compared with other alternatives?
- Where is the household's wood energy collected and/or produced?
- Is the resource base under threat of overexploitation, and, if so, what are the implications for household reliance?

Module A includes questions on quantities of fuelwood collected and charcoal processed by households, together with sources and labour expenditure. Module C includes questions on distance to the nearest supply source, household reliance on wood energy for different purposes, purchase of fuelwood and charcoal, and resource governance i.e. where fuelwood and wood for charcoal is collected, together with information on the legal ownership of the land and ease of access.

3.2.4. The World Bank Core Welfare Indicators Questionnaire Survey (CWIQ)

The CWIQ survey series was developed by the World Bank as an inexpensive tool to collect information on poverty, including access and satisfaction with social services and social welfare indicators. Generally, the surveys contain information related to housing conditions, water and sanitation, education, health care use and access, income and assets. There is no centralized resource for accessing CWIQ surveys, but many are listed in the International Household Survey Network's (IHSN) central survey catalogue²⁵.

The CWIQ core questionnaire²⁶ contains two fuelwood-related questions:

1. What is the main fuel used for cooking? (Firewood, Charcoal, Kerosene/oil, Gas, Electricity, Crop residue/sawdust, Animal waste, Other)
2. What is the main fuel used for lighting? (Kerosene/paraffin, Gas, Electricity, Generator, Battery, Candles, Firewood, Other)

Data from 23 CWIQ surveys covering 16 countries is available from the Global Health Data Exchange website²⁷:

- Burkina Faso Core Welfare Indicators Questionnaire Survey – 2003, 2005, 2007
- Cape Verde Core Welfare Indicator Questionnaire Survey – 2006, 2007
- Congo Household Survey for Poverty Assessment – 2005
- Ghana Core Welfare Indicators Survey – 1997
- Grenada Core Welfare Indicators Questionnaire Survey – 2005
- Guinea Unified Questionnaire on Basic Indicators of Well-Being – 2002-2003
- Guinea-Bissau Core Welfare Indicator Questionnaire Survey – 2002
- Lesotho Core Welfare Indicators Questionnaire – 2002
- Liberia Core Welfare Indicators Questionnaire Survey – 2007

²⁵ See Global Health Data Exchange for more information:

<http://ghdx.healthdata.org/series/core-welfare-indicators-questionnaire-survey-cwiq>.

²⁶ The World Bank Core Welfare Indicators Questionnaire Survey (CWIQ) core questionnaire may be consulted at <http://microdata.worldbank.org/index.php/catalog/1536/download/25214>.

²⁷ The Global Health Data Exchange website is available at

<http://ghdx.healthdata.org/series/core-welfare-indicators-questionnaire-survey-cwiq>.

- Malawi Core Welfare Indicators Questionnaire Survey – 2002
- Mozambique Core Welfare Indicators Questionnaire Survey – 2000-2001
- Nigeria Core Welfare Indicators Questionnaire Survey – 2002 (eight States), 2006
- Saint Lucia Core Welfare Indicators Questionnaire Survey – 2004
- Sierra Leone Core Welfare Indicators Questionnaire Survey – 2007
- United Republic of Tanzania: Kagera Core Welfare Indicators Questionnaire Survey – 2003
- United Republic of Tanzania: Shinyanga Core Welfare Indicators Questionnaire Survey – 2004
- United Republic of Tanzania: Core Welfare Indicators Questionnaire Survey – 2005, 2006-2007
- Togo Core Welfare Indicators Questionnaire – 2006

3.2.5. The UNICEF Multiple Indicator Cluster Survey (MICS)

MICSs are household surveys conducted around the world that focus mainly on issues affecting children and women. The topics addressed range from maternal and child health, education and child mortality to child protection, HIV/AIDS and water and sanitation. MICSs are based on standard questionnaires and modules chosen by individual countries, based on assessment of data gaps and needs. The survey activities are carried out by the implementing agencies with technical support from UNICEF. MICSs aim to be representative: the average sample size in the fifth round was of approximately 11,000 households, although the number varies greatly from one survey to another.

MICS 3 (2005-2008/9) standard questionnaires included questions on: the type of fuel mainly used for cooking in the household; whether food is cooked on an open fire, an open stove or a closed stove; whether the fire/stove has a chimney or hood; and whether cooking is usually done in the house, in a separate building, or outdoors (see Annex 4 to this Technical Report for more details).

MICS 4 (2009-12) and 5 (2013-16) standard questionnaires included questions on: the type of fuel mainly used for cooking in the household; whether cooking is done in the house, in a separate building, or outdoors; and whether if in the house, a separate room used as a kitchen (see Annex 4 for further details).

Customized questionnaires may include survey-specific questions or modules that are not included in the standard questionnaire, and may also exclude some

questions or modules that are part of the standard questionnaire. Assuming, however, that the standard fuel-related questions were included in all MICS 3, 4 and 5 surveys, information should be available for 84 countries, as shown in Annex 4.

3.2.6. The Demographic and Health Survey (DHS)

DHSs are nationally representative household surveys supported by USAID that provide data in the areas of population, health, and nutrition.²⁸

The DHS Household Questionnaire includes questions for the usual members of the household and visitors on age, sex, relationship to the head of the household, education, parental survivorship and residence, and birth registration. Questions are also included on source of drinking water, toilet facilities, cooking fuel, household assets, and exposure to secondhand smoke.

DHS Phases 4 (1997-2003), 5 (2003-2008), 6 (2008-2013) and 7 (2013-2018) contain the following questions on cooking fuel usage:

1. What type of fuel does your household mainly use for cooking? (Electricity/LPG/Natural gas/Biogas, Kerosene, Coal, Lignite, Charcoal, Wood, Straw/Shrubs/Grass, Agricultural crop, Animal dung, No food cooked in household, Other (Specify))
2. Is the cooking usually done in the house, in a separate building, or outdoors? (In the house, In a separate building, Outdoors, Other (Specify))

DHS Phases 5-7 have been conducted in 74 countries and, in some of these, on multiple occasions (details in Annex 5).

3.2.7. Who collections and surveys

The WHO conducts World Health Surveys (see below), supports the collection of information on cooking and heating practices (see Box 4), and compiles information on cooking practices in the WHO Household energy database²⁹. The information in the Household energy database is used as a proxy for exposure to household air pollution, and includes responses to questions from

²⁸ For an overview of DHSs, see: <http://www.dhsprogram.com/What-We-Do/Survey-Types/DHS.cfm>.

²⁹ The WHO Household energy database may be consulted at http://www.who.int/indoorair/health_impacts/he_database/en/.

nationally representative surveys on the primary cooking fuel in each household interviewed. A proportion of the available surveys also included questions on stove type, venting of smoke (“exhaust”) and cooking location, and permitted cross-tabulation by educational level of the woman respondent and by wealth quintile of the household.

The main multi-country surveys from which data are incorporated in the database are listed in Table 5, together with an indication of the information available. In addition, data are sourced from a wide range of individual country-initiated (national) surveys, all of which provide data on cooking fuel, and various combinations of the other topics listed in the table.

Table 5. Main multi-country surveys from which data in the WHO household energy database are derived

Survey	Cooking fuel	Cooking location	Stove type	Stove and other ventilation	Educational level of respondent	Wealth quintile of household
DHS	X	X	X	X	X	X
MICS	X	X	X	X	X	X
WHS ^a	X	X	X	X		X
LSMS	X				(X)	(X)

a. WHS: World Health Survey. X: Information is available; (X) information is sometimes available.

Box 4. Information on cooking and heating practices

International household surveys, such as the WHS (WHO), the MICS (UNICEF) and the DHS (ORCMacro/USAID) collect information on household energy practices. With support from the Aprovecho Research Center and with input from UNICEF and ORCMacro, the WHO prepared a set of four questions on cooking practices to aid standardization of information, and a stove card to facilitate correct assessment of stove type.

The four questions are:

1. What type of fuel does your household mainly use for cooking?
2. What type of stove is usually used for cooking?
 - a. Is smoke removed by a chimney or hood?
 - b. When was the chimney last cleaned?
3. Is the cooking usually done in an indoor living space, in a separate kitchen/building or outdoors?
4. What type of ventilation is present where the stove is used?

Response options are provided for all questions.

The WHS also includes questions on the type of fuel and type of stove used for heating.

Source: WHO Indoor air pollution - Information on cooking and heating practices: http://www.who.int/indoorair/health_impacts/cooking/en/.

As noted above, the WHO also maintains the GHO³⁰ data repository, which includes estimates of population using solid fuels for 194 countries. Most of the information held on the GHO is segregated according to urban vs. rural location. Many of the data sets represent the WHO's best estimates, using methodologies for specific indicators that aim for comparability across countries and time; they are updated as more recent or revised data become available, or when there are changes to the methodology being used.

3.2.7.1. The WHS

The WHS³¹ was launched by the WHO to strengthen national capacity to monitor health outcomes and systems through a valid, reliable and comparable household survey instrument. The WHS was implemented between 2002 and 2004 in countries selected to represent all regions of the world. Study samples were nationally representative.

Household data includes a household roster, health insurance coverage, health expenditures and indicators of permanent income or wealth. Individual-level data include sociodemographic information, health state descriptions, health state valuation, risk factors, chronic conditions, mortality, health care utilization, health systems responsiveness and social capital.

The long version of the individual questionnaire contains the following fuel-related questions:

- 4047. What type of fuel does your household mainly use for cooking? (1. Gas; 2. Electricity; 3. Kerosene; 4. Coal; 5. Charcoal; 6. Wood; 7. Agriculture/crop; 8. Animal dung; 9. Shrubs/grass; 10. Other.)
- 4048. What type of cooking stove is used in your house? (1. Open fire or stove without chimney or hood; 2. Open fire or stove with chimney or hood; 3. Closed stove with chimney; 4. Other.)
- 4049. Where is cooking usually done? (1. In a room used for living or sleeping; 2. In a separate room used as kitchen; 3. In a separate building used as kitchen; 4. Outdoors.)
- 4050. Do you heat your house when it is cold? (Yes/No)

³⁰ The GHO data repository, population using solid fuels (estimates) may be accessed at <http://apps.who.int/gho/data/node.main.135?lang=en>.

³¹ World Health Survey:

<http://apps.who.int/healthinfo/systems/surveydata/index.php/catalog/whs/about>

4051. What type of fuel does your household mainly use for heating? (1. Gas; 2. Electricity; 3. Kerosene; 4. Coal; 5. Charcoal; 6. Wood; 7. Agriculture/crop; 8. Animal dung; 9. Shrubs/grass; 10. Other.)

4052. What type of heating stove is used in your house? (1. Open fire or stove without chimney or hood; 2. Open fire or stove with chimney or hood; 3. Closed stove with chimney; 4. Other.)

The long version of the questionnaire was implemented in the following countries:

Bangladesh	Hungary	Philippines
Bosnia and Herzegovina	India	Russian Federation
Brazil	Kazakhstan	Senegal
Burkina Faso	Kenya	Slovakia
Côte d'Ivoire	Lao PDR	Slovenia
Chad	Latvia	South Africa
China	Malawi	Spain
Comoros	Malaysia	Sri Lanka
Congo	Mali	Swaziland
Croatia	Mauritania	Sweden (S)
Czech Republic	Mauritius	Tunisia
Dominican Republic	Mexico	Turkey
Ecuador	Morocco	Ukraine
Estonia	Myanmar	United Arab Emirates
Ethiopia	Namibia	Uruguay
Georgia	Nepal	Viet Nam
Ghana	Pakistan	Zambia
Guatemala	Paraguay	Zimbabwe

3.2.8. The labour force survey

Labour Force Surveys or similar tools are available for 178 countries on the International Labour Organization (ILO) website³². Generally, they are not a rich source of woodfuel-related information. However, a few reports do contain relevant information, such as the following:

- Botswana's Labour Force Survey 2005/6 contained questions on time and injuries associated with woodfuel use (see Box 5 below).
- Kenya's Economic Survey has information from the Kenya Forest Service on sale of fuelwood for 2010-2014.
- The Malawi Labour Force Survey 2013 included questions on economic activity, including collecting firewood meant for sale.

³² Labour Force Surveys: http://www.ilo.org/dyn/lfsurvey/lfsurvey.list?p_lang=en.

- Nepal's Labour Force Survey 2008 included a question on main type of cooking fuel.
- The Zimbabwe 2014 Labour Force Survey collected information on the main source of energy used by households for cooking, including wood.

In contrast, reports from the following countries did not contain any information on energy, wood or fuel, despite the national importance of woodfuel and energy access:

- Cambodia Labour Force Report for 2007
- China's Statistical Yearbooks Database
- Ghana's Living Standards Survey 2014
- The Report on the Labour Force Situation in Indonesia 2015
- Viet Nam's Report on the Labour Force Survey 2014

Box 5. 2005/06 Botswana's Labour Force Survey questions on woodfuel collection and use.

The survey questions may be summarized as follows:

1. Activities engaged in during the preceding 12 months, including firewood cutting/collection, and cooking;
2. Activities engaged in during the preceding seven days, including firewood cutting/collection;
3. Time spent on activities, including firewood collection and cooking, in the preceding seven days;
4. Whether the activities caused any problem with school attendance or studying, and the three main problems caused;
5. Whether activities, including firewood collection, contributed to difficulties with schooling;
6. Number of school days missed in the preceding 12 months and whether school has ever been missed due to various activities, including firewood collection.
7. The activity being undertaken if and when injury occurred in the preceding 12 months; the number of times injury has occurred in the preceding 12 months; the impacts of the injury; the type of activity being undertaken when the most serious injury occurred, including collecting firewood; the conditions experienced while undertaking the activity;
8. Whether illness has occurred because of difficult work conditions; how many times; the resulting impacts; the type of activity being performed when the most serious illness occurred.

Source: Botswana Labour Force Survey 2005/06, at http://www.cso.gov.bw/templates/cso/file/File/LFS_Report2005_2006.pdf

3.3. Household energy use surveys

In recent years, national energy agencies have increasingly been carrying out household energy use surveys, to assess patterns of energy use and thus inform the formulation of policies and programmes. The surveys focus on types of fuel used in different applications, sources and quantities of different fuels used and associated expenditures of time and money. Information on cooking apparatuses, household awareness of issues related to woodfuel use, and fuel preferences and associated reasons may also be collected.

The following subsections compare and contrast the questions posed in four household energy use surveys in Ghana, the Philippines, Swaziland and Uganda.

3.3.1. Ghana's household energy use survey

A household energy use survey carried out by the Ghana Energy Commission in 2014 included questions on the following:

1. Energy type used for: Lighting, Cooking, Refrigeration, Air conditioning, Washing Machine, Hot Water, Electrical Appliances, Generator.
 - 1.1. Fossil Fuels (LPG, Kerosene, Gasoline or Diesel)
 - 1.2. Electricity (From the grid, From generator set, From solar PV or From solar thermal)
 - 1.3. Traditional Fuel (Firewood or Charcoal)
 - 1.4. Biomass (Biogas or Agric Residue)
2. Whether these fuels are used for commercial activities (e.g. bread baking, street selling etc.) (Y/N)
3. Whether charcoal is used in the household (Y/N)
4. Source of charcoal
 - 4.1. Nearby Agent
 - 4.2. Local Retailer
 - 4.3. Local Market
 - 4.4. Distribution truck
 - 4.5. Own Farm

- 4.6. Other (specify)
5. Quantity of charcoal (weigh sample)
6. Number of days charcoal sample lasts (days/weeks/month)
7. Amount spent (days/weeks/month)
8. Whether firewood is used in the household (Y/N)
9. Source of firewood (response options as for Question 4 above)
10. Quantity of firewood (weigh sample)
11. Number of days firewood sample lasts (days/weeks/month)
12. Amount spent (days/weeks/month)

3.3.2. The Philippines' Household Energy Consumption Survey (HECS)

The HECS is an undertaking of the Philippines' NSO and Department of Energy (DoE). It has been conducted in 1989, 1995, 2004 and 2011 with the main objective of collecting and updating data and information on patterns of household energy consumption, application and other relevant factors. The complete results of the 2011 survey have not yet been released. However, the 2004 survey included a number of woodfuel-related questions. In particular, the following questions were asked separately in relation to fuelwood, biomass residues (including wood waste/sawdust) and charcoal, except where noted:

1. Whether household used fuelwood/biomass residue/charcoal from October 2003 to September 2004 (Y/N)
2. Fuelwood/biomass residue use (cooking, heating water for bathing, warming space, other purposes)
3. Charcoal use (cooking, heating water for bathing, ironing, other purposes)
4. Frequency of fuelwood/biomass residue/charcoal consumption
5. Amount of fuelwood/biomass residue/charcoal consumed each time
6. Average unit cost of fuelwood/biomass residue/charcoal
7. How fuelwood/biomass residue/charcoal consumed by the household was obtained (Purchased only, Self-collected/gathered, Both (purchased and gathered), others)
8. Frequency of fuelwood/biomass residue/charcoal purchase
9. The amount of fuelwood/biomass residue/charcoal bought at each purchase
10. The amount paid for fuelwood/biomass residue/charcoal at each purchase

11. How often charcoal produced [*not asked in relation to for fuelwood or biomass residue*]
12. Amount of charcoal the household produced each time [*not asked in relation to for fuelwood or biomass residue*]
13. Source of the fuelwood for making the charcoal (Own land, Private Land, Government land, Others) [*not asked in relation to for fuelwood or biomass residue*]
14. Amount paid for labour at each fuelwood purchase [*not asked in relation to charcoal*]
15. Amount paid for transport at each fuelwood purchase [*not asked in relation to charcoal*]
16. Amount paid for other expenses at each fuelwood purchase [*not asked in relation to charcoal*]
17. How fuelwood was bought (Delivered at home, Picked up from market/store) [*not asked in relation to charcoal*]
18. Frequency of fuelwood collection/gathering [*not asked in relation to charcoal*]
19. Amount of fuelwood the household usually collected/gathered each time [*not asked in relation to charcoal*]
20. Where fuelwood was gathered (Own land, Private land, Government land, Others) [*not asked in relation to charcoal*]
21. How much the self-collected/gathered/self-produced fuelwood/biomass residue/charcoal would cost, if bought

Other questions and areas covered were:

1. Kind of equipment (Woodstove, Wood oven, Biofuel stove, Flat iron, Charcoal stove, Others)
2. Equipment/Stove number
3. Type of fuel (Fuelwood, charcoal, biomass residues)
4. Type of usage (Cooking, heating water for bathing, ironing, others)
5. Frequency of use (Household)
6. Length of use (Household)
7. Did any member of your household cook anytime in September 2004? (Y/N)
8. What combination of fuel for cooking did you use most frequently in September 2004? (Primary) (Electricity, LPG, Kerosene, Fuelwood, Charcoal, Others)
9. What combination of fuel for cooking did you use most frequently in September 2004? (Secondary) (Electricity, LPG, Kerosene, Fuelwood, Charcoal, Others)

10. What type/combination of cooking fuel(s) did you use most frequently in the past 12 months? (Primary) (Electricity, LPG, Kerosene, Fuelwood, Charcoal, Others)
11. What type/combination of cooking fuel(s) did you use most frequently in the past 12 months? (Secondary) (Electricity, LPG, Kerosene, Fuelwood, Charcoal, Others)
12. Why did you change your primary cooking fuel? (Moved to another place, Previous fuel increased price, Change in income, New fuel is more available, New fuel is more convenient to use, Other reasons)
13. Did the household undertake measures to reduce fuel consumption from October 2003 to September 2004? (Y/N)
14. Did you practice the following domestic activities on the use of fuel? (Used efficient stove or appliances) (Y/N)
15. Without regard to price and availability, which fuel do you prefer most for cooking? (Fuelwood, Charcoal, Kerosene, LPG, Electricity, Biomass residue, Natural gas, Others)
16. Agree or disagree:
 - a. Fuelwood is difficult to get (Y/N)
 - b. Fuelwood is expensive (Y/N)
 - c. Fuelwood is dirty (Y/N)
 - d. Kitchen is inappropriate for fuelwood (Y/N)
 - e. Fuelwood is inconvenient to use (Y/N)
 - f. Cooking with commercial fuel is more expensive than fuelwood (Y/N)
 - g. Fuelwood gives hotter flame (Y/N)
 - h. Cooking with fuelwood creates better tasting dishes (Y/N)
 - i. Fuelwood gathering is a cause of forest denudation

3.3.3. Swaziland's Energy Access Household Survey

Swaziland's 2013 Energy Access Household Survey included the following woodfuel-related questions³³:

Energy use for cooking

1. What type of energy do you use for cooking as a primary source? (Wood, Electricity, LPG (Handigas), Paraffin, Solar, Other (specify).....)
2. What are your reasons for using the above source of energy? (Convenient, Affordable, The only one available, Other (specify).....)
3. What is your estimated monthly consumption in Emalangenzi (if not using Electricity)?
4. What main alternative do you use in case your primary source of cooking energy is not available? (Wood, Electricity, LPG (Handigas), Paraffin, Solar, Other (specify), None)

Wood usage

1. Have you heard about cleaner and wood-saving cookstoves? (Y/N)
2. Do you own a clean and wood-saving cookstove? (Y/N)
 - 2.1. Which of the following stove/s do you own? (Masheshisa, Vesto, Basintuthu, Modified welcome dover, Lion stove (Lubhubesi), Rocket baking oven (specify), Other (specify))
 - 2.2. If no, what are your reasons for not having one? (Expensive, Not available, Not interested, Other (specify))

Questions posed in households using woodfuel for cooking

1. Is there an area where you can collect firewood in your community? (Y/N)
2. Where do you source your wood fuel for cooking? (Communal forest, Private Forest, Purchase, Household yard, Other (specify).....)
3. Approximate the distance you travel to collect firewood (<1km, 1-2km, 3-5km, more than 5km)

³³ The Swaziland Energy Access Household Survey Questionnaire may be downloaded at: http://www.irena.org/DocumentDownloads/events/2015/Bioenergy%20Statistics%20Presentations/Household%20energy%20surveys/Swaziland_questionnaire.pdf.

4. How often do you collect firewood? Number of times per month.....
5. How much does it cost you to get firewood, per load? E.....
6. Is the firewood easily available? (Y/N)
7. Do you sometimes use other types of biomass as fuel e.g. cow dung, *emahlanga*, *iminyani*, dried grass, etc? (Y/N)
 - 7.1.1 If Yes, please specify.....
8. How do you make fire mainly for cooking? (Stove (including homemade), Open fire, Other (specify).....)
9. Do you think the use of wood-saving stoves can assist the people of the area? (Yes, Not sure, State reason(s).....)
10. Are you aware of the impact of cutting down trees? (Y/N)
11. If Yes, what is the impact of cutting down trees endlessly?
12. Are you aware of woodlotting? (Y/N)
 - 12.1.1 If yes, do you think it is necessary for the community to focus on woodlotting? (Y/N)
 - 12.1.2 If yes, do you think woodlotting could be sustainable for the community? (Y/N and if yes, how?

3.3.4. Uganda's Rural-Urban Electrification Survey

The Uganda Rural-Urban Electrification Survey 2012 included a single question on current sources of household energy, with response options including firewood and charcoal.³⁴

3.4. Survey-based woodfuel studies

Woodfuel use surveys are undertaken in the context of academic research, development studies, energy access assessments, environmental conservation efforts, public health investigations, local enterprise development and climate change mitigation. They may be implemented at a variety of scales – from local to national – and make use of extremely diverse and non-uniform information, corresponding to the particular objectives of the work involved.

³⁴ The Household Energy Surveys in Uganda are available at <http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=30&CatID=79&SubcatID=590&RefID=590&SubID=593&MenuType=Q>.

Because of the diverse nature and number of studies published³⁵, it is not possible to present a comprehensive review of the survey questions posed and hypotheses tested. Instead, this Section draws attention to a range of surveys implemented at different levels and for different purposes.

The studies performed in Cebu in the Philippines are interesting in relation to fuel switching, changes in woodfuel supply-demand balance and impact on forest conservation and enterprise development, during the long period over which the studies were conducted. The studies also investigated use of different types of fuelwood, including waste wood, which has important implications for emissions and sustainability, and species preferences. Similarly, Jarju (2008) focussed on tree parts used and preferred species in the Gambia (Section 3.4.2. below). The study also covered changes in collection time, fuelwood shortages, farmer perceptions regarding fuelwood sustainability and impact of fuelwood use on health and expenditure. The Suriname wood energy survey (Matai et al., 2015; Section 3.4.3. below) included many similar areas, while also collecting information on emissions and fossil fuel substitution. The Center for International Forestry Research-Poverty and Environment Network (CIFOR/PEN) prototype questionnaire focuses to a greater extent on forest resource tenure and access, as well as any changes in effort required to acquire woodfuel, and related responses including tree planting (Section 3.4.4.).

The Voluntary Carbon Standard (VCS) module on “Estimation of baseline emission from forest degradation caused by extraction of wood for fuel” guides project developers in determining fuelwood consumption. In particular, surveys must include verifiable measurements that are required to allow correlation between stated units of fuelwood consumed (e.g. logs or trees) and volumes (Section 3.4.5. of this Technical Report). Section 3.4.6. contains information on the baseline methodologies used in CDM and Gold Standard stove programs. These detail the acceptable methods used in determining woodfuel consumption prior to the dissemination of clean cookstoves, as a means of estimating emissions reduction and carbon credit issuance. In both cases, the survey’s requirements are simple and focus on determining the amount of woodfuel consumed per household member, using the existing cooking apparatus.

Two questionnaires set out in Annex 8 and Annex 9 to this Technical Report detail the woodfuel-related questions included in surveys implemented in

³⁵ A search for the words “fuelwood” or “firewood” in publications between 1996 and 2016 on Science Direct returned over 10,000 results: see <http://www.sciencedirect.com/science/search>.

Ethiopia and Nepal respectively. The Ethiopia questionnaire focuses primarily on energy use, and the Nepal questionnaire on forest management and livelihoods. Both include questions on woodfuel consumption and trends in availability; woodfuel source/s, their accessibility and time expenditure for collection; and responses to shortages. Questions on cooking practices and apparatus, and reasons in case improved cookstoves are not being used, are also included in both questionnaires.

3.4.1. Cebu, the Philippines

Three rounds of cross-sectional woodfuel studies have been conducted in Cebu, The Philippines (Bensel & Remedio, 1993; Remedio & Bensel, 2003; Remedio & Bensel, in prep.). The objectives of these studies concerned household and business woodfuel consumption; production, trade and distribution of woodfuels; and assessment of woodfuel-related practices and techniques. The surveys employed similar research methodologies, including structured household interviews on energy consumption, key informant interviews, focus group discussions among households, businesses, traders, government line agencies and local government units, and rapid rural appraisals to assess woodfuel management and harvesting practices. Data was also drawn from literature reviews, and woodfuel production figures were gathered from the national, provincial and local environment and natural resources offices and other bodies.

The household questionnaire used in the 1993 study is provided in Annex 7 to this Technical Report. The questionnaire includes questions on the respondent and the household, followed by a diverse range of questions on use of different fuel type and household cooking practices. Most questions are devoted to fuelwood use and cover reasons for fuelwood use, fuelwood purchase and collection, fuelwood source, fuelwood quantity used and fluctuations, fuelwood end uses and perceptions of fuelwood use and supply sustainability. The questionnaire poses more concise sets of questions for other fuels, including coconut shell/husk, charcoal, electricity, LPG, kerosene and other fuels.

In 2013, a similar survey was administered by questionnaire to 417 randomly selected households from 49 Cebu City central business district barangays and 8 Cebu City hilly land barangays. Information was collected in the following areas:

1. Fuelwood usage
 - a. Consumption of fuelwood (including weighing),
 - b. Source of fuelwood (Store/Market, Delivery, Collect, Coconut Palm, Scrap Wood/Waste, Others)
2. Coconut Shell/Husk usage
3. Charcoal usage
 - a. Consumption of charcoal (including weighing),
 - b. Source of charcoal (Store/Market, Delivery)
 - c. Charcoal Price
 - d. Charcoal usage
4. Electricity Usage
5. LPG usage
6. Kerosene usage
7. Other Fuel Usage
8. Fuel Switching
 - a. Best fuel for cooking? (LPG, Charcoal, Fuelwood, Electricity, Kerosene, Others, NA, Don't know)
 - b. Reasons for switching fuel?
 - c. Reasons for Household Fuel Choice Decisions? (Reasons to use and Reasons not to use Fuelwood, Charcoal, Kerosene, Electricity, LPG)

The 2013 survey also included Geographic Information System (GIS), mapping and partial forest assessment, and gathered information on “Woody Tree Species Selection”.

3.4.2. The Gambia

A fuelwood survey was administered in The Gambia in 1998 using a stratified random sample of 95 respondents (Jarju, 2008). These included 22 rural farmer

households, 14 urban households, 10 semi-urban households, 20 “chop shops” (small restaurants), and 29 schools. Responses were gathered in the following areas:

1. General farm/compound information
2. Fuelwood Statistics (fuel types and uses for households, schools and chop shops)
 - 2.1. Type of Fuel Stove Used by households, schools and chop shops
 - 2.2. Fuelwood Consumption Rates of households, schools and chop shops
3. Tree Parts Used (stem/branch/cut timber)
 - 3.1. Characteristics of Good Fuelwood Trees (responses included calorific value, smokelessness, wood density, long-lasting flame)
 - 3.2. Most Common Trees use for fuel (species)
 - 3.3. Occurrence of fuelwood shortages & seasonal variations
4. Collection Techniques
 - 4.1. Who Collects/Purchases (male/female, child/adult)
 - 4.2. Time Spent Collecting/Purchasing fuelwood and frequency
 - 4.3. Changes in Collection Times and Distance Travelled (increased/remained same/decreased and reasons for increase/decrease)
5. On-Farm Wood Production (whether respondents practice fuelwood production other than occasionally cutting trees on farm)
 - 5.1. Trees Left on the Farm (species present, species managed, whether consideration would be given to planting or managing trees on farms for fuelwood production)
 - 5.2. Decision Makers Tree Planting (husband/wife/family)
 - 5.3. Agroforestry techniques practised, reasons (including fuelwood production), whether visited by agents extending agroforestry techniques and the agency involved.
 - 5.4. Community Efforts in Tree Planting (whether involved with tree nurseries or community woodlots)
6. Farmers’ Opinion on/Attitude to Future Fuelwood Supplies (whether the forest and bush will continue to meet needs without intervention, and reasons)

7. Effect of Fuelwood Supplies on Household Budget and Nutrition (whether fuelwood purchase limits purchase of other necessary goods)
 - 7.1. Priority of Expenditure (prioritization of spending with available cash)
 - 7.2. Family Health (whether lack of fuelwood affects the number of cooked meals)
 - 7.3. Lack of Fuelwood Affecting Other Income-Generating Activities (whether lack of fuelwood affects other income-generating activities)

3.4.3. Suriname

A wood energy survey was conducted in Suriname between February 2013 and February 2015 (Matai et al., 2015). The survey began with a literature review. A questionnaire was then designed for collecting data from households and small-scale enterprises. The households sampled were those that used wood energy for cooking, as indicated in the 2012 national census. Aspects taken into consideration in the survey included:

- Quantity of energy wood consumed by households (families) and small-scale enterprises in different sectors
- Source of the energy wood
- Type of energy wood
- Timber species used as energy wood
- Technology applied during the consumption process
- Available quantity of wood for the generation of energy
- Emission of carbon due to the consumption methods
- Substitution of gas for cooking by energy wood

3.4.4. The Center for International Forestry Research Poverty Environment Network (CIFOR/PEN)

The Center for International Forestry Research Poverty Environment Network (CIFOR/PEN)³⁶ is a comprehensive global analysis of tropical forests and poverty. It includes survey data on over 8,000 households located in more than 40 study sites in a total of 25 developing countries. Comparative and detailed socioeconomic data was collected at the household and village levels on a quarterly basis, using standardized definitions, questionnaires and methods.

³⁶ Further information on the CIFOR/PEN is available at: <http://www1.cifor.org/pen>.

The study sites were chosen to represent different geographical regions, forest types, forest tenure regimes, levels of poverty, infrastructure and market access, and population density. The prototype PEN questionnaire includes the following questions, which focus or potentially focus on woodfuel:³⁷

Village survey

- The main products collected from different forest types and associated main users
- The most important product for the livelihood of the people in the village (including firewood or charcoal), the change in availability over the past five years, the reason for the change, and:
 - the type of forest in which the product is collected
 - the ownership status of the forest
 - the existence of customary rules regulating use of the product and whether enforced/respected
 - the existence of government rules regulating use of the product and whether enforced/respected
 - whether permission is required to harvest the product, whether there is an associated payment and who issues the permit

Household survey

1. How far, from the house/homestead, is the edge of the nearest natural or managed forest that you can access and use?
2. Does your household collect firewood? (If “no”, go to 8.)
3. If “yes”, how many hours per week do the members of your household spend on collecting firewood for family use? (adult time should be reported; child time = 50 percent of adult time)
4. Does your household now spend more or less time on getting firewood than you did five years ago?
5. How has the availability of firewood changed over the past five years?
6. If firewood has declined, how has the household responded to the decline in the availability of firewood? Please rank the most important

³⁷ The PEN prototype questionnaire may be consulted at <http://www1.cifor.org/pen/research-tools/the-pen-prototype-questionnaire.html>.

responses (max 3). (Increased collection time (e.g., from a farther distance from the house); Planting trees on private land; Increased use of agricultural residues as fuel; Buying (more) fuelwood and/or charcoal; Buying (more) commercial fuels (kerosene, gas or electricity); Reduced need for use of fuels, e.g. by using improved stove; More conservative use of fuelwood for cooking and heating; Reduced number of cooked meals; Use of improved technology; Increased use of non-wood wild products (e.g. reeds); Restricting access/use to own forest; Conserving standing trees for future; Making charcoal; Other, specify: ...)

7. Has your household planted any woodlots or trees on the farm over the past five years?
8. If yes, what are the main purpose(s) of the trees planted? Please rank the most important purposes (max 3). (Firewood for domestic use; Firewood for sale; Fodder for own use; Fodder for sale; Timber/poles for own use; Timber/poles for sale; Other domestic uses; Other products for sale; Carbon sequestration; Other environmental services; Land demarcation; To increase the value of my land; To allow my children and/or grandchildren to see these trees; Other, specify:...)

Questions were also included on the quantity of forest products used and sold, the land type from which they were collected and its ownership, the price for which they were sold, the type of market and the net income.

3.4.5. The VCS REDD-Methodology Framework

The VCS REDD-Methodology Framework VM0007 is the only VCS methodology covering non-renewable fuelwood collection. The methodology includes Module VMD0008 – “Estimation of baseline emission from forest degradation caused by extraction of wood for fuel.” Use of the module is mandatory in projects when the forest is expected to degrade due to fuelwood extraction or charcoal production. Guidance on quantifying fuelwood consumption is given in Annex 11 below.

Module VMD0008 guides project developers in determining fuelwood consumption and comprises two steps: (i) quantification of fuelwood consumption by household interview or Participatory Rural Appraisal (PRA), and (ii) enumeration of the total population that affects or may affect the project area. It is recommended to quantify fuelwood consumption, by reviewing local

studies and household interviews in which the interviewees are asked to describe fuelwood consumption and number of household members. Verifiable measurements are required, to enable correlation between stated units of fuelwood consumed (e.g. logs or trees) and volumes.

Of 25 VCS projects developed under VM0007, however, only one, The “Evio Kuiñaji Ese’Eja Cuana, To Mitigate Climate Change, Madre de Dios – Perú” project, uses VMD0008. The project is registered on the VCS Pipeline, but has not yet completed validation. Information on using the module may be available in the VCS project description when the project completes validation (VCS, pers. comm., 10 December 2015). Other projects in Belize, Bolivia, Brazil, Chile, Indonesia, Madagascar, Papua New Guinea, Paraguay, Peru and Sierra Leone found that extraction of wood for fuel was either sustainable or not occurring.

3.4.6. Cookstove programs

The methodologies developed to generate carbon credits from improved cookstove distribution programmes include guidance on estimating baseline fuelwood consumption; however, they often rely on national fuelwood consumption data. These data, together with figures on improved cookstove fuel usage and measured or default estimates of the fNRB³⁸, are used to calculate credit allocations.

The CDM provides methodologies aimed at selling carbon credits from clean cookstove programs into markets that comply with the United Nations Framework Convention on Climate Change (UNFCCC) regulations. The Gold Standard methodologies are applicable to the generation of carbon credits to be sold on voluntary carbon markets. Subsections 3.4.6.1. and 3.4.6.2. summarize the guidance provided by the CDM and the Gold Standard.

3.4.6.1. The CDM

According to CDM AMS-II.G. “Energy efficiency measures in thermal applications of non-renewable biomass” is a small-scale methodology for project activities that proposes introducing more efficient devices that use non-renewable biomass, or modernizing existing devices that reduce use of non-renewable biomass for combustion. As of January 2016, 34 registered clean

³⁸ The UNFCCC default fNRB values (national biomass removals minus biomass growth in protected areas, all divided by national biomass removals) may be viewed at: <https://cdm.unfccc.int/DNA/fNRB/index.html>.

cookstove carbon projects from developing countries have applied this methodology.³⁹ To determine the annual quantity of woody biomass used in a pre-project scenario, there are two options:

1. A default value of 0.5 tonnes/capita per year may be used to derive this parameter. The number of persons served per device shall be based on a survey conducted prior to project implementation. This option is limited to household project devices (e.g. ovens and dryers are not eligible).
2. Based on the historical data or a sample survey conducted in accordance with the latest version of the *Standard for Sampling and surveys for CDM project activities and programme of activities*, to determine the average annual consumption of woody biomass per device (tonnes/year). If the monitoring period is shorter or longer than one year, the result may be extrapolated for the monitoring period.

Project Design Documents and associated materials accessible through the CDM project search page⁴⁰ detail the baseline fuelwood consumption estimation methods used by registered projects, and include details of the surveys conducted.

3.4.6.2. The Gold Standard Simplified Methodology for Efficient Cookstoves

The Gold Standard Simplified Methodology for Efficient Cookstoves⁴¹ is designed for activities that introduce new fuelwood-burning cookstoves, to reduce the use of non-renewable fuelwood or switch from non-renewable to renewable fuelwood to meet household cooking needs. As of January 2016, 205 Gold Standard stove projects were listed in the Markit registry⁴².

³⁹ CDM project search: <https://cdm.unfccc.int/Projects/projsearch.html>.

⁴⁰ CDM project activities are detailed at <https://cdm.unfccc.int/Projects/index.html>.

⁴¹ For further information on the Gold Standard Simplified Methodology for Efficient Cookstoves, see <http://www.goldstandard.org/sites/default/files/documents/simplified-micro-scale-cookstove-methodology.pdf>.

⁴² The Markit Registry – Public View may be accessed at <https://mer.markit.com/br-reg/public/index.jsp?s=ca>.

The baseline fuel consumption survey included in the methodology covers the user's profile, cooking devices used, cooking location, and types and quantities of fuels used⁴³:

I. End user profile

Name _____ Gender _____
Family Members - Adult _____ Children _____
Address _____ Contact details _____

⁴³ The Gold Standard Simplified Methodology for Efficient Cookstoves is detailed at <http://www.goldstandard.org/sites/default/files/documents/gold-standard-simplified-micro-scale-cookstove-meth-2013.pdf>.

II. End user's fuel consumption pattern prior to project implementation

a. Cooking device:

Primary _____
Secondary _____
Other _____

b. Place for cooking:

Indoor
Open
Semi-open

c. Type of fuel used, including quantity and unit:

Wood - kg/month or year
LPG - kg or cylinders/month or year
Kerosene - litres/month or year
Charcoal - kg/month or year
Coal - kg/month or year
Electricity - kWh/month or year
Other fuels - kg or litres or m³/month or year

The survey guidelines note that in many cases, the end user may not be able to provide information on the quantity of cooking fuel in terms of the units mentioned; therefore, local measurement units should be used, and guidelines provided on their conversion to the required units (mass or volume).

Project Design Documents and associated materials accessible through the Markit registry provide details on the baseline fuelwood consumption estimation methods used by registered projects, including details of the surveys conducted.

Options for Improving Global Woodfuel Statistics

In efforts to improve estimates of woodfuel production and consumption in developing countries, several factors must be considered – not least, costs and technical challenges (Openshaw, 1979). The data, surveys and censuses reviewed in this report provide clear indications of routes to improving the accuracy of woodfuel consumption estimates. Several key points must be considered. First, a huge amount of information has been collected on woodfuel use since the 1990s; this information could be used in developing improved estimates of global woodfuel consumption on a relatively limited budget. Second, however, it should be taken into account that the data available often only cover the primary type of household cooking fuel used, and not quantities of woodfuel consumed. This information is of core importance in assessing global forest products production, forestry sector emissions and energy demand, and promoting sustainable natural resource management. A third point to consider is that households use woodfuels for purposes other than cooking, such as lighting and heating. Fourthly, few recent studies of commercial and industrial woodfuel consumption are available for developing countries, even though these sectors may contribute considerably to total national woodfuel consumption.

Given the availability of existing woodfuel related data, several options could be considered in improving global woodfuel consumption statistics and related information. Each takes into account the lack of quantification of consumption and other deficiencies in existing statistics to a different extent; and each option differs with respect to resource requirements, timescales for data improvements to be realized and the extent to which the accuracy of global woodfuel consumption estimates is likely to be improved:

1. Revise FAO's global woodfuel consumption estimates by updating GDP and population estimates and projections using existing models (see Broadhead et al., 2001).
2. Revise FAO woodfuel consumption models on the basis of additional data on woodfuel consumption published since 1996, woodfuel

consumption figures submitted to FAO by countries since 1998 and up-to-date GDP and population estimates and projections.

3. Develop a woodfuel module to be included in existing national surveys and ultimately initiate long-term improvements in woodfuel consumption statistics.
4. Develop a woodfuel module to determine the quantities of woodfuel consumed in samples of households identified, in recent national surveys, as using woodfuel as a primary cooking fuel. Sampling frameworks used in the national survey enable scaling measured woodfuel consumption to the national level; replication among a representative group of countries would provide sufficient data to significantly improve global woodfuel consumption statistics in a relatively short timespan.
5. Improve estimates of commercial and industrial woodfuel consumption through national level surveys, potentially run in tandem with implementation of a household woodfuel module.

An important point to consider in developing a woodfuel module is weighing wood, as this enables accurate estimations of consumption (FAO, 2002; Drigo, 2015). This will have significant implications on the survey teams' time and may require specific training; however, given the potential errors associated with estimating woodfuel consumption in "bundles" or similar terms, it may be necessary. Even if, on a house-to-house basis, consumption is recorded in bundles, conversion to weight will be necessary at some stage.

An additional consideration is the possible need to convert woodfuel quantities into energy quantities and the associated need to measure wood moisture content, given its considerable effect on the energy content (FAO, 2002). To measure moisture content, a moisture probe could be used. However, this will require additional time and training for survey teams, which may not be possible for modules that should be integrated into existing national surveys. Other areas to be considered are highlighted by Drigo (2015), as outlined in Box 6.

Box 6. Recommendations on woodfuel consumption surveys

Fuel saturation data from socioeconomic surveys

- National scale socioeconomic household surveys should include options for defining the second fuel, if not the actual mix of fuels, used by households.

Survey questionnaires

- Household consumption survey questionnaires should be as simple as possible, with the minimum essential number of questions, ranked on a priority basis and relying on direct measurements rather than attributions of values.

Distinction of fuelwood types

- A distinction between fuelwood types should be introduced, to help clarify the origin of the fuelwood; indeed, this influences the supply/demand balance and sustainability analyses.

Direct weighting of daily fuel consumption

- Woodfuel consumption rates (per capita or per household) should be derived from quantitative measurements carried out during the interview, rather than the interviewee's values.
- To achieve a good compromise between estimate precision and survey costs, the “average day” approach should be applied (see FAO, 2002).

Area of consumption

- The definition of urban/rural areas applied in the latest demographic census should be applied in woodfuel surveys, to enable the scaling-up of results to the national level.

Supply systems

- Formal (commercial woodfuel markets) and informal (direct collection or local, informal supply) woodfuel supply systems should be distinguished in woodfuel surveys, to enable assessment of supply sustainability.

Origin of woodfuels

- The source of woody biomass used as fuelwood or for charcoal production should be recorded in woodfuel surveys, to help determine the roles of forestry, agriculture and industry.
- In woodfuel surveys, the woodfuel categories defined by the Unified Bioenergy Terminology (UBET), including direct, indirect and recovered sources should be used (FAO, 2004).
- As for direct sources, it is recommended to maintain clear distinctions between forests (natural forests and forest plantations; other wooded lands) and other lands (farmlands, agricultural tree and shrub plantations, windbreaks, road trees, trees outside forests, etc.).

Source: Drigo (2015)

In developing a woodfuel module, information other than quantity of woodfuel consumed will be of interest. The objectives of the data collection effort will be of primary importance in defining the module's contents and are likely to be centred upon assessing woodfuel/energy demand, labour inputs, health implications and GHG emissions as a planning foundation for fuel substitution and/or sustainable woodfuel programmes. In this context, the FAO/IEA Criteria and Indicators for Sustainable Woodfuels provide a number of elements upon

which information could be collected by means of household surveys (see Box 7 and Annex 10).

Box 7. Criteria and indicators for sustainable woodfuels

Through direct and indirect questions, household surveys may yield information on a range of indicators for sustainable woodfuels developed by FAO, particularly under the following criteria (see Annex 10 for the specific questions):

- Criterion 2.1 – Land-use rights and ownership are clearly defined and established;
- Criterion 2.2 – Woodfuel production is planned and implemented in a transparent and participatory manner involving all relevant stakeholders.
- Criterion 2.4 – Woodfuel production contributes to the social and cultural development of local, rural and indigenous communities.
- Criterion 2.5 – Woodfuel production minimizes negative impacts on food security.
- Criterion 3.1 – Woodfuels represent the most beneficial use of woody biomass resources.
- Criterion 3.2 – Woodfuels are economically viable.
- Criterion 3.3 – Woodfuels contribute to local/rural economic prosperity and the livelihoods of local residents.
- Criterion 4.1 – Ecological resistance and resilience at the landscape level is maintained or enhanced.
- Criterion 4.2 – Woodfuel production does not degrade ecosystems and landscapes.
- Criterion 4.3 – Biodiversity is maintained or enhanced at the landscape level.

Households may be able to provide information on indicators for sustainable charcoal production, particularly under the following criteria (as for the above, see Annex 10):

- Criterion 2.1 – The relationship between human culture and forest management and charcoal production is recognized and respected.
- Criterion 2.3 – Livelihoods are improved through the sustainable production and consumption of charcoal.

Information on indicators under other criteria and principles must be collected separately, through a national assessment or village- and district-level surveys.

Source: FAO and IEA Bioenergy (2010)

Different thematic emphases will be appropriate in different contexts; auxiliary themes could be explored in additional household or community woodfuel modules for uptake by countries as required. If different modules covering different themes are developed, it will be important to ensure that a core module covers basic information, to facilitate international data comparison. The core module should also gather information on explanatory variables of use in scaling up woodfuel-related information to national and global levels, such as household income and urban/rural location of household. This information is likely to be collected as part of the national survey into which the woodfuel module is integrated; however, where the module is used alone, such basic information will have to be gathered specifically.

It may be necessary to consider developing different types of module for use at different levels, in addition to collecting data solely at the household level (FAO, 1983). This will be particularly necessary in assessing quantities that vary at different levels. For example, information on woodfuel source/production and the socioeconomic and environmental context may be best collected through focus group discussions and key informant interviews at the community level (FAO, 2016). Where commercial and industrial production and consumption of woodfuel is the focus, assessments at the national, regional or provincial level, as appropriate, are likely to be necessary. Box 8 outlines other important points to be considered in developing surveys, including areas touched upon above.

Box 8. Key points of the conclusions and recommendations from the Proceedings of the International Workshop on Energy Survey Methodologies for Developing Countries. 21-25 January 1980, Jekyll Island, Georgia, US.

- Surveys must address the identified problems. The nature of the problem/s will help define the questions asked and the sampling framework.
- Surveys should be designed and directed by the institutions that will make use of the information and, as such, should be designed so that the institution/s can absorb the results and make use of them to formulate and inform decisions.
- Surveys may need to be diverse. Some directed to a particular immediate decision; others directed to a broader range of policy concerns, including problems that may arise over the long term.
- In most cases, no survey methods or approaches are universally applicable; they must be designed for local situations and for the specific policy needs of a country, drawing on experience of other regions and countries, particularly other developing countries.
- The type of information necessary will be determined not only by policy issues, but also by the analytical approach required. For example, time-series data or data on underlying determinants of demand for different energy sources may be necessary, for projecting future energy demand.
- Surveys should be designed and carried out in as flexible a manner as possible, such that initial findings can shape the survey if important information is discovered. For this to happen, however, those who understand the basic policy issues and analytical approaches must be involved in carrying out the survey.
- In most energy decisions, there is a trade-off between energy and other elements, and one must be certain that the associated important information is either available or gathered along with the energy information.

Source: National Academy of Sciences (1980)

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Annex 1

The LSMS

LSMS surveys containing information on household energy and fuel are available for 37 countries, as shown below. The hyperlinks frequently provide access to the questionnaires used.

Country	Year	Survey name and link to information
Albania	1996	Employment and Welfare Survey
Albania	2002	Living Standards Measurement Survey
Albania	2003	Living Standards Measurement Survey Wave 2 Panel
Albania	2004	Living Standards Measurement Survey Wave 3 Panel
Albania	2005	Living Standards Measurement Survey
Armenia	1996	Household Budget Survey
Azerbaijan	1995	Survey of Living Conditions
Bosnia and Herzegovina	2001	Living Standards Measurement Survey
Bosnia and Herzegovina	2002	Living in Bosnia and Herzegovina Survey
Bosnia and Herzegovina	2003	Living in Bosnia and Herzegovina Survey
Bosnia and Herzegovina	2004	Living in Bosnia and Herzegovina Survey
Brazil	1997	Survey of Living Conditions
Bulgaria	1995	Integrated Household Survey
Bulgaria	1997	Integrated Household Survey
Bulgaria	2001	Integrated Household Survey
Bulgaria	2003	Multitopic Household Survey
Bulgaria	2007	Multitopic Household Survey
Burkina Faso	2014	Enquête Multisectorielle Continue
China	1995	Heibe and Liaoning Living Standards Survey
Côte d'Ivoire	1985	Enquête Permanente Auprès des Ménages
Côte d'Ivoire	1986	Enquête Permanente Auprès des Ménages
Côte d'Ivoire	1987	Enquête Permanente Auprès des Ménages
Côte d'Ivoire	1988	Enquête Permanente Auprès des Ménages
Ecuador	1994	Encuesta Condiciones de Vida
Ecuador	1995	Encuesta Condiciones de Vida
Ecuador	1998	Encuesta Condiciones de Vida
Ethiopia	2011	Rural Socioeconomic Survey
Ethiopia	2013	Socioeconomic Survey
Ghana	1987	Living Standards Survey
Ghana	1988	Living Standards Survey

Ghana	1991	<u>Living Standards Survey</u>
Ghana	1998	<u>Living Standards Survey</u>
Guatemala	2000	<u>Encuesta Nacional sobre Condiciones de Vida</u>
Guyana	1992	<u>Living Standards Measurement Survey</u>
India	1997	<u>Uttar Pradesh and Bihar Survey of Living Condition...</u>
Iraq	2006	<u>Iraq Household Socio-Economic Survey</u>
Iraq	2012	<u>Iraq Household Socio-Economic Survey</u>
Jamaica	1988	<u>Survey of Living Conditions</u>
Jamaica	1989	<u>Survey of Living Conditions</u>
Jamaica	1989	<u>Survey of Living Conditions</u>
Jamaica	1990	<u>Survey of Living Conditions</u>
Jamaica	1991	<u>Survey of Living Conditions</u>
Jamaica	1992	<u>Survey of Living Conditions</u>
Jamaica	1993	<u>Survey of Living Conditions</u>
Jamaica	1994	<u>Survey of Living Conditions</u>
Jamaica	1995	<u>Survey of Living Conditions</u>
Jamaica	1996	<u>Survey of Living Conditions</u>
Jamaica	1997	<u>Survey of Living Conditions</u>
Jamaica	1998	<u>Survey of Living Conditions</u>
Jamaica	1999	<u>Survey of Living Conditions</u>
Jamaica	2000	<u>Survey of Living Conditions</u>
Kazakhstan	1996	<u>Living Standards Measurement Survey</u>
Kyrgyzstan	1993	<u>Living Standards Survey</u>
Kyrgyzstan	1996	<u>Living Standards Survey</u>
Kyrgyzstan	1997	<u>Living Standards Survey</u>
Kyrgyzstan	1998	<u>Living Standards Survey</u>
Malawi	2004	<u>Second Integrated Household Survey</u>
Malawi	2010	<u>Third Integrated Household Survey</u>
Malawi	2013	<u>Third Integrated Household Survey</u>
Morocco	1991	<u>Enquête Nationale sur le Niveau de Vie des Ménages...</u>
Nepal	1996	<u>Living Standards Survey</u>
Nepal	2003	<u>Living Standards Survey</u>
Nepal	2010	<u>Living Standards Survey</u>
Nicaragua	1993	<u>Encuesta Nacional de Hogares sobre Medición de Niv...</u>
Nicaragua	1998	<u>Encuesta Nacional de Hogares sobre Medición de Niv...</u>
Nicaragua	1999	<u>Encuesta Nacional de Hogares sobre Medición de Niv...</u>
Nicaragua	2001	<u>Encuesta Nacional de Hogares sobre Medición de Niv...</u>
Nicaragua	2005	<u>Encuesta Nacional de Hogares sobre Medicion de Niv...</u>
Niger	2011	<u>Enquête National sur les Conditions de Vie des Mén...</u>
Nigeria	2010	<u>GHS Panel Survey</u>
Nigeria	2012	<u>GHS Panel Survey</u>
Pakistan	1991	<u>Integrated Household Survey</u>
Panama	1997	<u>Encuesta de Niveles de Vida</u>
Panama	2003	<u>Encuesta de Niveles de Vida</u>
Panama	2008	<u>Encuesta de Niveles de Vida</u>

Papua Guinea	New	1996	<u>Household Survey</u>
Peru		1985	<u>Encuesta Nacional de Hogares sobre Medición de Niv...</u>
Peru		1990	<u>Encuesta de Hogares sobre Medición de Niveles de V...</u>
Peru		1991	<u>Encuesta Nacional de Hogares sobre Medición de Niv...</u>
Peru		1994	<u>Encuesta Nacional de Hogares sobre Medición de Niv...</u>
Romania		1994	<u>Integrated Household Survey</u>
Serbia		2000	<u>Kosovo Living Standards Measurement Survey</u>
Serbia		2002	<u>Living Standards Measurement Survey</u>
Serbia		2003	<u>Living Standards Measurement Survey</u>
Serbia		2007	<u>Living Standards Measurement Survey</u>
South Africa		1993	<u>Integrated Household Survey</u>
Tajikistan		1999	<u>Living Standards Measurement Survey</u>
Tajikistan		2003	<u>Living Standards Measurement Survey</u>
Tajikistan		2007	<u>Living Standards Survey</u>
Tajikistan		2009	<u>Living Standards Survey</u>
Tanzania		1991	<u>Kagera Health and Development Survey Wave 1</u>
Tanzania		1992	<u>Kagera Health and Development Survey Wave 2</u>
Tanzania		1993	<u>Kagera Health and Development Survey Wave 3</u>
Tanzania		1993	<u>Human Resource Development Survey</u>
Tanzania		1994	<u>Kagera Health and Development Survey Wave 4</u>
Tanzania		2004	<u>Kagera Health and Development Survey Wave 5</u>
Tanzania		2008	<u>National Panel Survey</u>
Tanzania		2010	<u>National Panel Survey</u>
Tanzania		2010	<u>Kagera Health and Development Survey Wave 6</u>
Tanzania		2010	<u>National Panel Survey</u>
Timor-Leste		2001	<u>Living Standards Survey</u>
Timor-Leste		2007	<u>Survey of Living Standards</u>
Uganda		2009	<u>National Panel Survey</u>
Uganda		2010	<u>National Panel Survey</u>
Uganda		2011	<u>National Panel Survey</u>
Viet Nam		1992	<u>Living Standards Survey</u>
Viet Nam		1997	<u>Living Standards Survey</u>
Viet Nam		2002	<u>Household Living Standards Survey</u>
Viet Nam		2004	<u>Household Living Standards Survey</u>

Source: <http://iresearch.worldbank.org/lsm/lsmssurveyFinder.htm>.

Annex 2

Malawi national surveys including woodfuel-related questions

There is no specific survey on woodfuel in Malawi. Rather, a number of surveys conducted by the National Statistics Office include woodfuel-related questions. One of these surveys is the Malawi Integrated Household Survey, which is conducted every five years (Lewis Gombwa, National Statistical Office Malawi, pers. comm., 15 December 2015)

The Malawi Third Integrated Household Survey 2010/11 included the following questions⁴⁴:

1. How many hours did you spend yesterday collecting firewood (or other fuel materials)?
2. What is your main source of lighting fuel? (Collected firewood, Purchased firewood, Grass, Paraffin, Electricity, Gas, Battery/Dry, Cell (Torch), Candles, Other (Specify))
3. What is your main source of cooking fuel? (Collected firewood, Purchased firewood, Paraffin, Electricity, Gas, Charcoal, Crop residue, Sawdust, Animal waste, Other (Specify))
4. Do you ever use firewood for fuel? (Y/N)
5. Do you ever collect firewood? (Y/N)
6. Where do you go to collect firewood? (Own woodlot, Community woodlot, Forest reserve, Unfarmed areas of community, Other (Specify))
7. How long does it take you to walk from your dwelling to where you usually go to collect firewood?
8. Of the firewood you used in the past week, how much of it did you purchase? (All, Almost all, More than half, Half, Less than half, A little, None)
9. What is the total value of the firewood you used in the past week, whether gathered or purchased? (Estimate purchase cost of gathered firewood.)

⁴⁴ Malawi Third Integrated Household Survey, 2010/11. Available at: <http://siteresources.worldbank.org/INTLSMS/Resources/3358986-1233781970982/5800988-1271185595871/IHS3.Household.Qx.FINAL.pdf>.

10. Do you have electricity working in your dwelling? (Y/N)

11. In the event of a black out, what source of energy do you use for:

11.1. Lighting? (Firewood, Paraffin, Candles, Other (Specify))

11.2. Cooking? (Charcoal, Firewood, Gas, Paraffin, Other (Specify))

Annex 3

Woodfuel-related modules included in Bakkegaard et al. (in prep.)

Bakkegaard et al. (in prep.) include modules covering woodfuel use for integration into LSMS surveys. Information on different aspects of woodfuel use is collected in Core Household Modules A and C, as detailed below.

Core household module A: income

Module A includes questions on household income sources and earnings over the past 12 months, and includes four sub-modules on (1) Income from Forest and Wild Products; (2) Wage Income; (3) Business Income; and (4) Other Forest-Related Income Sources, Including Payments for Environmental Services (PES) Programmes.

Module A1 covers potential collection of fuelwood and includes the questions outlined in the following subsection.

Module A1. Income from forest and wild products

- 1.1. During the past 12 months, have you or any member of your household collected any *forest products* or *other wild products* (e.g. from grasslands, fallows, etc.), for either your own use or sale?
- 1.2. Who primarily collected the product?
- 1.3. How many household members were collecting this product?
- 1.4. From where is the product collected?
 - a. old growth natural forest
 - b. secondary/regenerating forest
 - c. managed plantation forest
 - d. other non-forest environment with planted trees, trees on farms or tree farms
 - e. other non-forest environment with natural vegetation
- 1.5. Labour
 - a. In the last 12 months, how many weeks did [HOUSEHOLD (HH)] spend collecting [PRODUCT]?

- b. In those weeks, how many days per week were used to collect [PRODUCT]?
 - c. On those days, how many hours per day were spent collecting [PRODUCT]?
- 1.6. What is the total quantity collected? (1.8 +1.9)
- 1.7. What is the unit of collection?
- 1.8. What is the quantity used? (including gifts)
- 1.9. What is the quantity sold? (including barter)
- 1.10. What is the price per unit?
- 1.11. What is the gross value of sales? (1.6*1.10)
- 1.12. What are the transport/marketing costs? (TOTAL)
- 1.13. What is the cost of purchased and own inputs plus hired labour?
- 1.14. What is the net income? (1.11-1.12-1.13)
- 1.15. During the past 12 (twelve) months, have you or any member of your household processed any *forest products* or *other wild products* (e.g. from grasslands, fallows, etc.), for either your own use or sale?
- 1.16. Who primarily processed the product?
- 1.17. How many household members were involved in processing this product?
- 1.18. Labour
 - a. In the last 12 months, how many weeks did [HH] spend processing [PRODUCT]?
 - b. In those weeks, how many days per week were used to process [PRODUCT]?
 - c. On those days, how many hours per day were spent processing [PRODUCT]?
- 1.19 What is the total quantity processed? (1.21 +1.22)
- 1.20 What is the unit of product?
- 1.21 What is the quantity used? (incl. gifts)
- 1.22 What is the quantity sold? (incl. barter)
- 1.23 What is the price per unit?
- 1.24 What is the gross value of sales? (1.19*1.23)

1.25 What are the transport/marketing costs? (TOTAL)

1.26 What is the cost of hired labour, purchased and own raw material and inputs used for processing?

1.27 What is the net income? (1.24-1.25-1.26)

Core household module C: forest resource – energy, health and construction

Module C covers the use of forests and wild products for household energy, health and construction purposes. Module C1 covers information on distance to the forest resource; Module C2 covers use, collection and purchase of fuelwood and charcoal, as detailed in the following subsections. Modules C3 and C4 cover, respectively, Forests and Health and Forests and Construction; they are not reviewed here.

C1. Forest resource base

1.1. How far is it from the house/homestead to the edge of the nearest natural or managed forest that you have access to and can use?

- a. Measured in terms of distance (one way)?
- b. Measured in minutes (one way) of main mode of transport (1 = walking; 2 = boat; 3 = car/lorry; 4 = bike; 99 = other, specify:....)

C2. Forests and energy – fuelwood and charcoal

2.1. Have you or anyone in your HH used [PRODUCT] for cooking, lighting, heating or water sterilization in the past 12 months?

2.2. When using [PRODUCT] for cooking, how much do you rely on it compared with other energy sources (e.g. gas, electricity)?

0 = not used at all

1 = very little

2 = about half of the time

3 = mostly

4 = always

-9 = don't know

2.3. When using [PRODUCT] for water sterilization, how much do you rely on it compared with other energy sources (e.g. gas, electricity)? (responses as per 2.2)

2.4. When using [PRODUCT] for heating, how much do you rely on it compared with other energy sources (e.g. gas, electricity)? (responses as per 2.2)

2.5. When using [PRODUCT] for lighting, how much do you rely on it compared with other energy sources e.g. gas, electricity? (responses as per 2.2)

2.6. Do you purchase any of your [PRODUCT]?

2.7. How much of your [PRODUCT] is purchased?

1 = very little

2 = about half

3 = most

4 = all >> NEXT PRODUCT

-9 = don't know

2.8. From where do you collect this [PRODUCT]?

1 = Old-growth natural forest

2 = Secondary or regenerating natural forest

3 = Managed plantation forest

4 = other non-forest environment with trees, trees on farms (e.g. cultivated areas) or tree farms

5 = other non-forest environment with natural vegetation

99 = other, specify:

2.9. What is the legal ownership (tenure) status of the land where you collect [PRODUCT]?

1 = communal

2 = private

3 = state-owned

2.10 How easily can your household access this land in practice, without concern for penalties?

1 = very easy

2 = *somewhat easy*
3 = *neither difficult nor easy*
4 = *somewhat difficult*
5 = *very difficult*

Annex 4

The UNICEF MICS

Household cooking fuel questions are included in MICS 3 and shown in Table 6 below. Those included in MICS 4 and 5 are shown in Table 7.

Assuming that these standard questions were included in all MICS 3, 4 and 5 surveys, information should be available for 84 countries, as shown in Table 8.

Table 6. MICS 3 (2005-2008/9) standard household questionnaire fuel-related questions

<p>HC6. WHAT TYPE OF FUEL DOES YOUR HOUSEHOLD MAINLY USE FOR COOKING?</p>	<p>Electricity Liquid Propane Gas (LPG) Natural gas Biogas Kerosene Coal/Lignite Charcoal Wood Straw/shrubs/grass Animal dung Agricultural crop residue Other (<i>specify</i>) _____</p>
<p>HC7. IN THIS HOUSEHOLD, IS FOOD COOKED ON AN OPEN FIRE, AN OPEN STOVE OR A CLOSED STOVE? <i>Probe for type.</i></p>	<p>Open fire Open stove Closed stove Other (<i>specify</i>) _____</p>
<p>HC7A. DOES THE FIRE/STOVE HAVE A CHIMNEY OR A HOOD?</p>	<p>Yes No</p>
<p>HC8. IS THE COOKING USUALLY DONE IN THE HOUSE, IN A SEPARATE BUILDING, OR OUTDOORS?</p>	<p>In the house In a separate building Outdoors Other (<i>specify</i>) _____</p>

Table 7. MICS 4 (2009-12) and 5 (2013-16) standard household questionnaire fuel-related questions

<p>HC6. WHAT TYPE OF FUEL DOES YOUR HOUSEHOLD MAINLY USE FOR COOKING?</p>	<p>Electricity Liquefied Petroleum Gas (LPG) Natural gas Biogas Kerosene Coal/Lignite Charcoal Wood Straw/Shrubs/Grass Animal dung Agricultural crop residue</p> <p>No food cooked in household</p> <p>Other (<i>specify</i>) _____</p>
<p>HC7. IS THE COOKING USUALLY DONE IN THE HOUSE, IN A SEPARATE BUILDING, OR OUTDOORS?</p> <p><i>If “In the house”, probe: IS IT DONE IN A SEPARATE ROOM USED AS A KITCHEN?</i></p>	<p>In the house In a separate room used as kitchen Elsewhere in the house In a separate building Outdoors</p> <p>Other (<i>specify</i>) _____</p>

Table 8. MICS surveys including fuel-related questions

Country	Year	Data set availability (as of Dec 2015)
Afghanistan	2010-2011	Available
Albania	2005	Available
Algeria	2012-2013	Not yet available
Algeria	2006	Not available
Argentina	2011-2012	Available
Bangladesh	2012-2013	Available
Bangladesh	2006	Available
Barbados	2012	Available
Belarus	2012	Available
Belarus	2005	Available
Belize	2015	Not yet available
Belize	2011	Available
Belize	2006	Available
Benin	2014	Not yet available
Bhutan	2010	Available
Bosnia and Herzegovina	2011-2012	Available
Bosnia and Herzegovina	2006	Available
Bosnia and Herzegovina (Roma Settlements)	2011-2012	Available
Burkina Faso	2006	Available
Burundi	2005	Available
Cameroon	2014	Not yet available
Cameroon	2006	Available
Central African Republic	2010	Available
Central African Republic	2006	Available
Chad	2010	Available
Congo	2014-2015	Not yet available
Congo, Democratic Republic of the	2010	Available
Costa Rica	2011	Available
Côte d'Ivoire	2016	Not yet available
Côte d'Ivoire	2006	Available
Cuba	2014	Available
Cuba	2010-2011	Available
Cuba	2006	Available
Djibouti	2006	Available
Dominican Republic	2014	Not yet available
Egypt (Sub-national)	2013-2014	Not yet available
El Salvador	2014	Not yet available

Gambia	2010	Not yet available
Gambia	2005-2006	Available
Georgia	2005	Available
Ghana	2011	Available
Ghana	2006	Available
Ghana (Accra)	2010-2011	Available
Ghana (District)	2007-2008	Not available
Guinea	2016	Not yet available
Guinea-Bissau	2014	Not yet available
Guinea-Bissau	2010	Not yet available
Guinea-Bissau	2006	Available
Guyana	2014	Not yet available
Guyana	2006-2007	Available
Indonesia (Papua Selected Districts)	2011	Available
Indonesia (West Papua Selected Districts)	2011	Available
Iraq	2015	Not yet available
Iraq	2011	Available
Iraq	2006	Available
Jamaica	2011	Available
Jamaica	2005	Available
Kazakhstan	2015	Not yet available
Kazakhstan	2010-2011	Available
Kazakhstan	2006	Available
Kenya (Bungoma County)	2013-2014	Not yet available
Kenya (Eastern Province)	2008	Not available
Kenya (Kakamega County)	2013-2014	Not yet available
Kenya (Mombasa Informal Settlements)	2009	Available
Kenya (Nyanza Province)	2011	Available
Kenya (Turkana County)	2013-2014	Not yet available
Korea, Democratic People's Republic of	2009	Restricted
Kosovo	2013-2014	Available
Kosovo (Roma, Ashkali, and Egyptian Communities)	2013-2014	Available
Kyrgyzstan	2014	Not yet available
Kyrgyzstan	2005-2006	Available
Lao People's Democratic Republic	2011-2012	Available
Lao People's Democratic Republic	2006	Available
Lebanon (Palestinians)	2011	Available
Lebanon (Palestinians)	2005-2006	Available
Macedonia, The Former Yugoslav Rep. of	2011	Available
Macedonia, The Former Yugoslav Rep. of	2005-2006	Available

Macedonia, The Former Yugoslav Rep. of (Roma settlements)	2011	Available
Madagascar (South)	2012	Available
Malawi	2013-2014	Available
Malawi	2006	Available
Mali	2015	Not yet available
Mali	2009-2010	Not yet available
Mauritania	2015	Not yet available
Mauritania	2011	Available
Mauritania	2007	Available
Mexico	2015	Not yet available
Moldova, Republic of	2012	Available
Mongolia	2013-2014	Not yet available
Mongolia	2010	Available
Mongolia	2005	Available
Mongolia (Khuvsgul Aimag)	2012	Available
Mongolia (Nalaikh District)	2012	Not yet available
Montenegro	2013	Available
Montenegro	2005-2006	Available
Montenegro (Roma Settlements)	2013	Available
Mozambique	2008	Available
Myanmar, Republic of the Union of	2009-2010	Not available
Nepal	2014	Available
Nepal (Mid- and Far-Western Regions)	2010	Available
Nigeria	2016	Not yet available
Nigeria	2011	Available
Nigeria	2007	Available
Oman	2014	Not yet available
Pakistan (Balochistan)	2010	Available
Pakistan (Khyber Pakhtunkhwa)	2015	Not yet available
Pakistan (Punjab)	2014	Not yet available
Pakistan (Punjab)	2011	Available
Pakistan (Sindh)	2014	Not yet available
Panama	2013	Available
Qatar	2012	Not yet available
Saint Lucia	2012	Available
Sao Tome and Principe	2014	Not yet available
Sao Tome and Principe	2006	Not available
Senegal (Dakar City)	2015	Not yet available
Serbia	2014	Available
Serbia	2010	Available

Serbia	2005-2006	Available
Serbia (Roma settlements)	2014	Available
Serbia (Roma settlements)	2010	Available
Sierra Leone	2010	Available
Sierra Leone	2005-2006	Available
Somalia	2006	Available
Somalia (Northeast Zone)	2011	Available
Somalia (Somaliland)	2011	Available
South Sudan, Republic of	2016	Not yet available
South Sudan, Republic of	2010	Available
State of Palestine	2014	Not yet available
State of Palestine	2010	Available
Sudan	2014	Not yet available
Sudan	2010	Available
Suriname	2010	Available
Suriname	2006	Available
Swaziland	2014	Not yet available
Swaziland	2010	Available
Syrian Arab Republic	2006	Available
Syrian Arab Republic (Palestinian Refugee Camps & Gatherings)	2006	Not available
Tajikistan	2005	Available
Thailand	2015	Not yet available
Thailand	2012-2013	Not yet available
Thailand	2005-2006	Available
Thailand (15 Provinces)	2015	Not yet available
Togo	2010	Available
Togo	2006	Available
Trinidad and Tobago	2011	Not yet available
Trinidad and Tobago	2006	Available
Tunisia	2011-2012	Available
Tunisia	2006	Not available
Turkmenistan	2015	Not yet available
Turkmenistan	2006	Available
Ukraine	2012	Available
Ukraine	2005	Available
United Arab Emirates	2015	Not yet available
Uruguay	2012-2013	Not yet available
Uzbekistan	2006	Available
Vanuatu	2007-2008	Available
Viet Nam	2013-2014	Available

Viet Nam	2010-2011	Available
Viet Nam	2006	Available
Yemen	2006	Available
Zimbabwe	2014	Available
Zimbabwe	2009	Available

Annex 5

Demographic and Health Surveys (DHS) data sets containing information on cooking fuel use

1. Albania	2008-09
2. Armenia	2000, 2005, 2010
3. Azerbaijan	2006
4. Bangladesh	1999-00, 2004, 2007, 2011
5. Benin	2001, 2006, 2011-12
6. Bolivia	2003, 2008
7. Burkina Faso	2003, 2010
8. Burundi	2010
9. Cambodia	2000, 2005, 2010, 2014
10. Cameroon	2004, 2011
11. Cape Verde	2005
12. Chad	2004
13. Colombia	2000, 2005, 2010
14. Comoros	2012
15. Congo (Brazzaville)	2005, 2011-12
16. Congo Democratic Republic	2007, 2013-14
17. Côte d'Ivoire	2011-12
18. Dominican Republic	1999, 2002, 2007, 2007, 2013, 2013
19. Egypt	2000, 2003, 2005, 2008, 2014
20. Equatorial Guinea	2011
21. Eritrea	2002
22. Ethiopia	2000, 2005, 2011
23. Gabon	2000, 2012
24. Gambia	2013
25. Ghana	1998, 2003, 2006, 2008, 2011, 2014
26. Guatemala	1998-99
27. Guinea	2009, 1992, 1999, 2005, 2012
28. Haiti	2000, 2005-06, 2012
29. Honduras	2005-06, 2011-12
30. India	1998-99, 2005-06
31. Indonesia	2002-03, 2007, 2012
32. Jordan	2002, 2007, 2009, 2012
33. Kazakhstan	1999
34. Kenya	2003, 2008-09
35. Kyrgyz Republic	2012
36. Lao PDR	2011-12
37. Lesotho	2004, 2009
38. Liberia	2007, 2013
39. Madagascar	2003-04, 2008-09
40. Malawi	2000, 2004, 2010
41. Maldives	2009
42. Mali	2001, 2006, 2012-13
43. Mauritania	2000-01, 2003-04

44. Moldova	2005
45. Morocco	2003-04
46. Mozambique	2003, 2011
47. Namibia	2000, 2006-07, 2013
48. Nepal	2001, 2006, 2011
49. Nicaragua	2001
50. Niger	2006, 2012
51. Nigeria	1999, 2003, 2008, 2013
52. Pakistan	2006-07, 2012-13
53. Peru	2000, 2004-06, 2007-08, 2009, 2010, 2011, 2012, 2013, 2014
54. Philippines	2003, 2008, 2013
55. Rwanda	2000, 2005, 2007-08, 2010
56. Samoa	2009
57. Sao Tome and Principe	2008-09, 2014
58. Senegal	1999, 2005, 2010-11, 2012-13, 2014
59. Sierra Leone	2008, 2013
60. South Africa	2003
61. Sri Lanka	2006-07
62. Swaziland	2006-07
63. Tajikistan	2012
64. United Rep. of Tanzania	1999, 2004-05, 2010
65. Timor-Leste	2009-10
66. Togo	2013-14
67. Turkey	1998, 2003
68. Turkmenistan	2000
69. Uganda	2000-01, 2006, 2011
70. Ukraine	2007
71. Vietnam	2002
72. Yemen	2013
73. Zambia	2001-02, 2007, 2013-14
74. Zimbabwe	1999, 2005-06, 2010-11

Source: <http://www.dhsprogram.com/data/available-datasets.cfm>

Annex 6

Developing countries, according to the IMF World Economic Outlook 2015

1. Afghanistan
2. Albania
3. Algeria
4. Angola
5. Antigua and Barbuda
6. Argentina
7. Armenia
8. Azerbaijan
9. Bahamas
10. Bahrain
11. Bangladesh
12. Barbados
13. Belarus
14. Belize
15. Benin
16. Bhutan
17. Bolivia
18. Bosnia and Herzegovina
19. Botswana
20. Brazil
21. Brunei Darussalam
22. Bulgaria
23. Burkina Faso
24. Burundi
25. Cambodia
26. Cameroon
27. Cape Verde
28. Central African Republic
29. Chad
30. Chile
31. China
32. Colombia
33. Comoros
34. Democratic Rep. Congo
35. Republic of the Congo
36. Costa Rica
37. Côte d'Ivoire
38. Croatia
39. Djibouti
40. Dominica
41. Dominican Republic
42. Guinea
43. Guinea-Bissau
44. Guyana
45. Haiti
46. Honduras
47. Hungary
48. India
49. Indonesia
50. Iran
51. Iraq
52. Jamaica
53. Jordan
54. Kazakhstan
55. Kenya
56. Kiribati
57. Kyrgyzstan
58. Lao PDR
59. Lebanon
60. Lesotho
61. Liberia
62. Libya
63. Macedonia
64. Madagascar
65. Malawi
66. Malaysia
67. Maldives
68. Mali
69. Marshall Islands
70. Mauritania
71. Mauritius
72. Mexico
73. Myanmar
74. Fed. States of Micronesia
75. Republic of Moldova
76. Mongolia
77. Montenegro
78. Morocco
79. Mozambique
80. Namibia
81. Nepal
82. Nicaragua
83. Niger
84. Nigeria
85. Oman
86. Senegal
87. Serbia
88. Seychelles
89. Sierra Leone
90. Solomon Islands
91. Somalia
92. South Africa
93. South Sudan
94. Sri Lanka
95. Sudan
96. Suriname
97. Swaziland
98. Syrian Arab Republic
99. Tajikistan
100. Tanzania, United Rep. of
101. Thailand
102. Timor-Leste
103. Togo
104. Tonga
105. Trinidad and Tobago
106. Tunisia
107. Turkey
108. Turkmenistan
109. Tuvalu
110. Uganda
111. Ukraine
112. United Arab Emirates
113. Uruguay
114. Uzbekistan
115. Vanuatu
116. Venezuela
117. Viet Nam
118. Yemen
119. Zambia
120. Zimbabwe

42. Ecuador
43. Egypt
44. El Salvador
45. Equatorial Guinea
46. Eritrea
47. Ethiopia
48. Fiji
49. Gabon
50. The Gambia
51. Georgia
52. Ghana
53. Grenada
54. Guatemala
100. Pakistan
101. Palau
102. Panama
103. Papua New Guinea
104. Paraguay
105. Peru
106. Philippines
107. Poland
108. Qatar
109. Romania
110. Russia
111. Rwanda
112. Saint Kitts and Nevis
113. Saint Lucia
114. St Vincent and the Grenadines

Annex 7

Household energy questionnaire used in study on “patterns of commercial woodfuel supply, distribution and use in the city and province of Cebu, Philippines.”⁴⁵

[The “Commercial Establishment Energy-Use Questionnaire” and “Urban Woodfuel Trader Questionnaire” are also available.]

B.1 Household energy questionnaire

Section A: Respondent qualification/enumerator information

- A.1 Does the respondent make most of the fuel purchase decisions for the household?
- A.2 Does the respondent do most of the household cooking?
- A.3 Is the respondent aware of the types and amounts of fuels used in the household?
- A.4 Names of enumerators.
- A.5 Date of Interview.
- A.6 Time begun and time finished.

Section B: Respondent information

- B.1/B.2/B.3 Name/Sex/Age of respondent.
- B.4 Highest level of education achieved by respondent?
- B.5 Primary occupation of respondent?
- B.6 Respondent/Household address.

⁴⁵ Bensel & Remedio (1993). Available at:
<http://wgbis.ces.iisc.ernet.in/energy/HC270799/RWEDP/acrobat/fd42.pdf>.

Section C: Household Information

- C.1 Names of household members (list).
- C.2 Ages of household members (list).
- C.3 Sex of each household member (list).
- C.4 Primary occupation of household members (list).
- C.5 Monthly income from each primary occupation (list).
- C.6 Secondary occupation of household members (list).
- C.7 Monthly income from each secondary occupation (list).
- C.8 Other sources of income (pensions, remittances from abroad, etc.)
for each household member (list).
- C.9 How long has the household been residing in Cebu City?
- C.10 Place of residence before moving to Cebu City (if applicable)?

Section D: Housing Information

- D.1 Status of the dwelling (owned, rented, etc.).
- D.2 If rented, what is monthly rent?
- D.3 If owned, can respondent estimate imputed monthly rent?
- D.4 Is the residence used only as living quarters, or as living quarters
and work area?
- D.5 If applicable, what kind of work is done on the premises?
- D.6 Type of dwelling (single family home, duplex, apartment, etc.).
- D.7 How many rooms in the residence?
- D.8 Is the place of meal preparation within the house, separate from the
house, or both?

Section E: Fuelwood Usage

- E.1 Does the household use fuelwood? (If yes, skip to E.5, if no, answer E.2-E.4 and go to Section F)
- E.2 If no, what are your reason(s) for not using fuelwood? (open-ended)
- E.3 Are any of the following also a reason for your decision not to use fuelwood? (list of precoded options)
- E.4 Of the above reasons for not using fuelwood, what is the most important reason of all?
- E.5 Does the household purchase fuelwood from a store or market?
- E.6 How many times a week does the household purchase fuelwood?
- E.7 What amount is usually purchased each time?
- E.8 How far is the place of purchase from your residence?
- E.9 Does the household have fuelwood delivered to it?
- E.10 How many times a month is fuelwood delivered?
- E.11 How much is usually delivered each time?
- E.12 Who delivers fuelwood to the household?
- E.13 Does the household collect its own fuelwood?
- E.14 How many times a month do you collect fuelwood?
- E.15 How much wood is usually collected each time?
- E.16 Where is the wood usually collected from (own land, neighbor's land, garbage dump, riverbank, etc.)?
- E.17 Which members of the household are usually responsible for collecting fuelwood?
- E.18 Does the household use coconut fronds?
- E.19 What share of overall household fuelwood use is in the form of coconut fronds?

- E.20 Does the household use scrap wood/construction waste?
- E.21 Where do you get the scrap wood from?
- E.22 What share of overall household fuelwood use is in the form of scrap wood?
- E.23 What share, if any, of overall household fuelwood use is for the preparation of animal feeds?
- E.24 What share, if any, of overall household fuelwood use is for commercial activities?
- E.25 Why do you use fuelwood? (open-ended)
- E.26 Are any of the following also a reason for your decision to use fuelwood? (list of precoded options)
- E.27 Of the above reasons for using fuelwood, what is the most important reason of all?
- E.28/E.29/E.30 Do you plan on continuing to use fuelwood for the next one/three/five years?
- E.31 Would you like to stop using fuelwood?
- E.32 Why do you want to stop using fuelwood?
- E.33 What is preventing you from discontinuing your use of fuelwood?
- E.34 What was the price you paid for fuelwood the last time you purchased it?
- E.35 Have you noticed any fluctuations or changes in the price of fuelwood during the past year?
- E.36 Please explain these fluctuations or changes?
- E.37 How much wood does your household usually consume in one day? (for E.34 and E.37, actual weighings are conducted)
- E.38 Are there times of the year or special occasions when your use of fuelwood increases or decreases substantially?
- E.39 What are those occasions and how does it affect fuelwood use (increase or decrease)?
- E.40 Do you think there are enough wood/trees in Cebu to meet woodfuel demand for the next 5 years?

E.41 Do you think there are enough wood/trees in Cebu to meet woodfuel demand for the next 10 years?

Section F: Coconut Shell/Husk Usage

F.1 Does the household use coconut shells/husks? (If yes, skip to F.5, if no answer F.2-F.4 and go to Sec. G)

F.2 What are your reason(s) for not using coconut shells/husks? (open-ended)

F.3 Are any of the following also a reason for your decision not to use coconut shells/husks? (pre-coded)

F.4 Of the above reasons for not using coconut shells/husks, what is the most important reason?

F.5 Does the household purchase coconut shells/husks from a store or market?

F.6 Does the household have coconut shells/husks delivered to it?

F.7 Does the household collect its own coconut shells/husks?

F.8 What share, if any, of total household usage of coconut shells/husks is for preparation of animal feeds?

F.9 What share, if any, of total household usage of coconut shells/husks is for commercial activities?

F.10 Why do you use coconut shells/husks?

F.11 What quantity of coconut shells/husks does your household usually consume in one day/week?

Section G: Charcoal Usage

G.1 Does the household use charcoal? (If yes, skip to G.5, if no, answer G.2-G.4 and go to Section H)

G.2 If no, what are your reason(s) for not using charcoal? (open-ended)

- G.3 Are any of the following also a reason for your decision not to use charcoal? (list of pre-coded options)
- G.4 Of the above reasons for not using charcoal, what is the most important reason of all?
- G.5 Does the household purchase charcoal from a store or market?
- G.6 How many times a week does the household purchase charcoal?
- G.7 What amount is usually purchased each time?
- G.8 How far is the place of purchase from your residence?
- G.9 Does the household have charcoal delivered to it?
- G.10 How many times a month is charcoal delivered?
- G.11 How much is usually delivered each time?
- G.12 Who delivers charcoal to the household?
- G.13 What share, if any, of overall household charcoal use is for the preparation of animal feeds?
- G.14 What share, if any, of overall household charcoal use is for commercial activities?
- G.15 What was the price you paid for charcoal the last time you purchased it?
- G.16 Have you noticed any fluctuations or changes in the price of charcoal during the past year?
- G.17 Please explain these fluctuations or changes?
- G.18 How much charcoal does your household usually consume in one week?
- G.19 Are there times of the year or special occasions when your use of charcoal increases or decreases substantially?
- G.20 What are those occasions and how does it affect charcoal use (increase or decrease)?

G.21 Do you use charcoal only for ironing, only for cooking, or some combination of the two? (If a combination, provide an estimate of approximate usage for each)

G.22 Why do you use charcoal for cooking?

Section H: Electricity Usage

H.1 Does the household use electricity? (If yes, skip to H.5, if no, answer H.2-H.4 and go to Section J)

H.2 If no, what are your reason(s) for not using electricity? (open-ended)

H.3 Are any of the following also a reason for your decision not to use electricity? (pre-coded options)

H.4 Of the above reasons for not using electricity, what is the most important reason of all?

H.5 Do you receive electricity from a utility, a neighbor, a generator?

H.6 Do you use electricity for cooking?

H.7 If yes, which of the following electric cooking appliances do you use and what is frequency of use?

H.8 Why do you cook with electricity?

H.9 Do you use electricity for lighting?

H.10 How many of each type of electric lamps (fluorescent, incandescent) are used in the home?

H.11 Do you use electricity for other appliances?

H.12 Which of the following electrical appliances is used in the home and how many of each? (pre-coded list)

H.13 Do you use electricity for commercial activities?

H.14 Which appliances are used for commercial activities?

H.15 Can you estimate monthly electric charges for the household?

Section J (no Section I to avoid encoding errors): LPG Usage

J.1 Does the household use LPG?

(If yes, skip to J.5, if no, answer J.2-J.4 and go to Section K)

J.2 If no, what are your reason(s) for not using LPG? (open-ended)

J.3 Are any of the following also a reason for your decision not to use LPG? (pre-coded options)

J.4 Of the above reasons for not using LPG, what is the most important reason of all?

J.5 Is LPG used for cooking?

J.6 Why do you cook with LPG?

J.7 How frequently do you cook with your LPG cooking device?

J.8 Do you use LPG for commercial activities?

J.9 Besides cooking, are there any other uses for LPG in the household (e.g. lighting)?

J.10 What size containers do you purchase LPG in?

J.11 How frequently do you usually need to refill these containers?

J.12 How much do you pay per container?

J.13 Do you pick up the LPG yourself or is it delivered?

J.14 If picked up, how far is the place of purchase from your residence?

Section K: Kerosene Usage

K.1 Does the household use kerosene?

(If yes, skip to K.5, if no, answer K.2-K.4 and go to Section L)

K.2 If no, what are your reason(s) for not using kerosene? (open-ended)

K.3 Are any of the following also a reason for your decision not to use kerosene? (pre-coded options)

- K.4 Of the above reasons for not using kerosene, what is the most important reason of all?
- K.5 Is kerosene used for cooking?
- K.6 What type of kerosene stove do you use (e.g. gravity-feed, pressure, wick-type)?
- K.7 Why do you use kerosene for cooking?
- K.8 How frequently do you cook with your kerosene stove?
- K.9 Do you use kerosene for lighting?
- K.10 How many of each type of kerosene lamp do you use?
- K.11 Do you use kerosene for commercial activities?
- K.12 Besides cooking and lighting are there any other uses for kerosene in the home (e.g. fire starter)?
- K.13 What size containers do you usually purchase kerosene in?
- K.14 How frequently do you have to refill these containers?
- K.15 What is the price per container?
- K.16 How far is the place of purchase from your residence?

Section L: Other Fuel Usage

- L.1 Does the household use any other fuels (e.g. sawdust, corn cobs, wood shavings, etc.)?
- L.2 Please list the other fuels used, modes of procurement, and prices paid?
- L.3 What are these used for and how much is consumed?

Section M: Household Cooking Practices

- M.1 What types of stoves does the household keep on the premises?
- M.2 Which stove does the household use the most?
- M.3 If applicable, how much did your wood stove cost?
- M.4 How frequently do you utilize your wood stove?

- M.5 If applicable, how much did your charcoal stove cost?
- M.6 How frequently do you utilize your charcoal stove?
- M.7 If applicable, how much did your kerosene stove cost?
- M.8 How frequently do you utilize your kerosene stove?
- M.9 If applicable, how much did your LPG stove cost?
- M.10 How frequently do you utilize your LPG stove?
- M.11 If applicable, how much did your electric stove cost?
- M.12 How frequently do you utilize your electric stove?
- M.13 If applicable, how much did your “other” stove cost?
- M.14 How frequently do you utilize your “other” stove?
- M.15 How many times a day does the household usually cook meals?
- M.16 On the average, how often does the household purchase cooked prepared off the premises?
- M.17 On the average, how often do household members eat meals out at *carenderias* and eateries?
- M.18 Does the household boil its drinking water?
- M.19 What stove is usually used for boiling drinking water?
- M.20 Does the household boil water for bathing?
- M.21 What stove is usually used for boiling water for bathing?
- M.22 Has the household changed its primary cooking fuel during the last five years? (excluding temporary switches of short duration due to stove problems or lack of supply)
- M.23 From which fuel to which fuel did you switch (list all switches)?
- M.24 What was the reason(s) for each switch?
- M.25 Ignoring prices, costs of stoves, and whether the fuel is available or not, which fuel do you think is best for cooking?

Section N: Conclusion

- N.1 For the purpose of our survey, we need to have a rough estimate of the income of your family from all sources. In which of these groups (display flash card) did your total family income fall for an average month in the past year? (Used to cross-check figures reported for C.5, C.7 and C.8)
- N.2 (For enumerator) How would you rate the respondent's degree of cooperation?
- N.3 (For enumerator) How would you rate the accuracy/validity of their responses?
- N.4 (For enumerator) If another survey were to be done, would this be a good household to interview?

Annex 8

Woodfuel-related questions contained in questionnaire for studies on rural energy and household forest values under varying management regimes in Ethiopia⁴⁶

Section 1.2.3. Health and biomass energy, cooking and consumption habits

1. In your opinion, does the use of fuelwood, dung and crop residues cause health problems? (Y/N)
2. What type of kitchen do you have? (Living area, Separate room, Outdoors)
3. Do you think cooking smoke affects the health of women or children? (Y/N)
4. If the answer to question 8 is yes, then do you think cooking smoke causes:
 - a. breathing (or chest) problems in children? (Y/N)
 - b. breathing problems in women who do the cooking? (Y/N)
5. Do you think some cooking fuels are better for your health than others? (Y/N)

Section 3.1. Energy consumption per week

1. Energy type (Wood, Dung, Charcoal, Branches of tree, Leaves, Crop residues, Kerosene, diesel or benzene, Electricity, Other)
2. For what purpose did you use it? (Cooking, Lighting, Heating, Other)
3. Quantity used (*Kiremt* season)
4. Quantity used (*Bega* season)

Section 3.2.1. Biomass Collection, Purchase and Sales per Week

1. Fuel type (Firewood, Dung, Charcoal, Branches of tree, Leaves, Crop residues, Other)

⁴⁶ Beyene, Bluffstone and Mekonnen (2015).

2. Source (Own property, Natural forest, Community forest, Government/state forest, Bought from market, Property of other individuals, Other (specify))
3. Season (*Kiremt/Bega*)
4. Trips/week
5. Quantity per trip
6. Quantity unit
7. Travel time (both ways in hours)
8. Collection time (hours)
9. Total quantity sold last year
10. Total Amount
11. Price/Unit
12. What are the [three preferred] coping mechanisms of the household in case of shortage of [the following] resources? Fuelwood, Dung, Charcoal, Other fuels like crop residues, Fodder, Timber, Water, Other (Specify)
 - a. Spend more time for collection
 - b. Reduce consumption
 - c. Shift to other traditional sources like residues and dung
 - d. Substitution from private trees
 - e. Buy from market
 - f. Change in cooking habits
 - g. Use of improved stoves
 - h. Other (specify)
13. How available is the supply of the resource in satisfying your demand? (Excess supply, Enough, Shortage, The resource is not available and they satisfy their demand from market)
14. What about five years ago? (Was better, The same, Worse)

Section 3.3. Cooking and consumption habits

1. Do you use improved cooking stoves? (Y/N) If No, then go to question 5.
2. What type(s) of improved stove/s do you use? (Multiple answers are possible)
 - a. Stove with three stones
 - b. Circular stove made from mud

- c. Ethiopian metal stove (*yekesel*)
 - d. Clay stove (“*burayu* stove”)
 - e. *Lakech* improved charcoal stove
 - f. *Mirt injera* stove
 - g. Kerosene stove
 - h. Other (specify)
3. When did the household start to use the stove? (*Lakech* ____ *Mirt* ____
Burayu ____)
4. Why do you use each of the following improved stoves? Rank them, Write 1 for the most important reason. (*Lakech* ____ *Mirt* ____
Burayu ____ Other ____)
- a. Easy to use
 - b. Environmentally friendly
 - c. Very cheap
 - d. Save time for cooking
 - e. Uses less fuelwood
 - f. Other (please specify)
- If the respondent answers Q 4, go to Question 7
5. Why have you chosen not to use an improved stove? (Unavailability, do not know its use, expensive, not durable, Other (please specify))
6. Ask the following question if the household has been using the stoves but not using currently.
- a. When did the household stop using the technology (improved stove)? (*Lakech* ____ *Mirt* ____ *Burayu* ____ Other ____)
 - b. For how long was the household using the improved stoves (in years)? (*Lakech* ____ *Mirt* ____ *Burayu* ____ Other ____)
7. How many meals per day did household members over ten years old eat in the last month?
- How about members under age ten?
8. How many times do you (on average) cook food (other than *injera* or *Kocho*) per day?
9. How many times do you bake *injera*/prepare *Kocho* per week on average? *Injera* _____ *Kocho* _____
10. Was there a change in the frequency of meals eaten or cooking activity in the household? (Y/N)

If the answer to 10 is yes, please indicate the changes in frequency of meals and cooking and the reason. (Scarcity of fuel, Food shortage, Change in number of household members, Easy availability of fuel, Easy availability of food, Other (specify))

11. What are the two most preferred energy types for cooking by the household in descending order of importance? (Wood, Dung, Charcoal, Branches of tree, Leaves, Crop residues, Kerosene, diesel or benzene, Electricity, Other)

12. What are the reasons for choosing these energy types? (It is cheap, Easily available, It is well known, We don't have other choice, Its effectiveness, Availability, Comfortable/convenient, Clean, Other (specify))

Reason (s) for the most preferred _____

Reason (s) for the second most preferred _____

13. Do you use dung and fuel wood at the same time for cooking? (Y/n)

If yes, why? (To save energy, We don't have enough wood, We don't have enough dung, It is a culture to do so, Other (specify))

14. If you had more fuelwood, would you use more or less dung as fuel? (Less, More, No change)

Section 4.2. Forest institutions: Household Perception of Forest Use and Management

25. Do you or any member of the family require any permission to collect forest products? (Y/N)

- a. Fuelwood
- b. Fodder
- c. Grass
- d. Bamboo
- e. Craft materials
- f. Medicinal plants
- g. Honey
- h. Spices
- i. Others (specify)

26. How often do you need to get permission to collect fuelwood from forest? (Every time I collect fuelwood, Yearly, Just one time, No permission is required)

27. Is there any restriction on the amount of each type of forest product you collect from the forest? (Y/N)

Annex 9

Woodfuel-related questions contained in Nepal community forestry program and UN-REDD – making community forestry pro-poor carbon sequestration policy household survey questionnaire⁴⁷

Section 2. Forest management

2.8 What is your perception of forest management in your community forest?
(Strongly Agree, Agree, No Opinion, Disagree, Strongly disagree)

2.8.1 There are limits on how much fuelwood we can collect from our forest?

2.8.2 Other villagers would be very unhappy with us if they found that we had taken more than our allotment of fuelwood, fodder or grazing.

2.8.3 If we took more fuelwood from the forest than we were allowed to take, we would face some sort of punishment.

2.8.4 We would feel embarrassed or bad if we took more than our allotment of fuelwood, fodder or grazing.

2.9 Do you or any member of the family require any permission to collect the following forest products? (Y/N) Fuelwood, Timber, Leaf litter, Grass, Grazing, Honey, Medicinal plants.

2.10 How often do you need to get permission to collect fuelwood from forest?
(Every time I collect, Yearly, Just once, Never)

2.11 Is there any restriction on the amount of each type of forest product you collect from the forest? (Y/N)
If yes, which ones? Fuelwood, Timber, Leaf litter, Grass, Grazing, Honey, Medicinal plants.

⁴⁷ Bluffstone et al. (2015).

2.3 Demand and supply of forest products

What kind of forest products do you need? How much? How did you get them? Fuelwood, Timber, Poles, Grass, Fodder, Leaf litter, Medicinal plant, Mulching, Coal, Others (please indicate).

2.3.1 Total demand (Quantity)

2.3.2 Available from CF (Quantity)

2.3.3 State of supply from CF in last five years (1 = increasing, 2 = Decreasing, 3 = No Change)

2.3.4 Which of the following products do you get from the forest? (multiple products possible): Firewood, Grasses, Herbs, Timber, Fodder, Leaf litter, Poles, Straw, I do not get products from the forest.

2.3.5 Which of the above forest products is most important? (please choose only one)

2.3.6 How do you fulfil any unmet requirements for forest products? From own land, By buying, From other forest.

2.3.7 If buying, how much do you spend per year?

2.3.8 If firewood collection from the forest were to be restricted by one-quarter (25%) from current levels, from where would you make up this energy difference (check all that apply):

Community forest, Biogas, LP gas, Crop residues, Other Non-CF forest, Coal, Dung, Kerosene, Fuelwood from own land, Electricity, Energy conservation, Purchase fuelwood.

2.3.9 If firewood collection from the forest were to be restricted by one-half (50%) from current levels, from where would you make up this energy difference (check all that apply):

Categories as for 2.3.8.

2.3.10 If firewood collection from the forest were to be restricted by three-quarters (75%) from current levels, from where would you make up this energy difference (check all that apply):

Categories as for 2.3.8.

2.3.11 If firewood collection from the forest were to be completely restricted (100%) from current levels, from where would you make up this energy difference (check all that apply):

Categories as for 2.3.8.

Section 6: Access to assets and services

6.2. Physical status of household

6.2.15 On average, how many meals per day did household members over ten years old eat in the last month?

6.2.16 On average, how many meals per day did household members under ten years old eat in the last month?

6.2.17 On average, how many times do you (on average) cook food per day?

6.2.18 Which kind of fuel do you use for cooking? (Tick all major sources based on rank)

Firewood, Biogas, LP gas, Dried small branches, Coal, Dung Brickett, Keresone, Sawdust stove, Other...

For each answer, how much do you use per month?

6.2.19 What is your most important cooking fuel? Firewood, Biogas, LP gas, Gobar Gas, Dried small branches, Coal, Dung bricket, Kerosene, Sawdust, Other (specify)

6.2.20 Do you use dung and fuelwood at the same time for cooking? (Y/N)

6.2.20.1 If yes why?

6.2.21 If you had more fuelwood would you use more or less dung as fuel? (less, more, no change)

6.2.21.1 If you would use less dung as fuel, what would you use it for?

6.2.22 Please provide the following information for each household member for the last time she/he gathered fuelwood from the main forest (not from own farmland) from which she/he gathers fuelwood

6.2.22.2 Source

6.2.22.3 Season

6.2.22.4 Quantity per trip (kg)

6.2.22.5 Travel time (both ways in hours)

6.2.22.6 Collection Time (hours)

6.2.23 How much fuelwood did you sell last year in kg?

6.2.23.1 What was the average price of that (per kg)?

6.2.24 How much fuelwood did you buy last year in kg?

6.2.24.1 What was the average price of that (per kg)?

6.2.25 For each household member, on average during the last six months, how many fuelwood collection trips were made each week?

6.2.26 Do you use an improved stove? (Y/N)

6.2.26.1. If no, why have you chosen not to use an improved stove? (Unavailability, do not know its use, expensive, not durable, Other (please specify))

6.3. Landholding

6.3.1 Does your family own land? (Y/N)

6.3.2 If yes, who owns the property (Female, Male, Both)

6.3.3 How did you manage to own this property? (Parental, Purchased (bought from self-earned money), Others (please specify))

6.3.4 How much total land does your family own?

6.3.8 Description of land use in hectares (For each land type: Farmland, Rainfed land, Kitchen garden, Private forest, *Kharbari*, Others (specify))

6.3.9 Self-use (hectares)

6.3.10 Taken on Lease (hectares)

6.3.11 Given on lease (hectares)

6.3.12 Others (hectares)

6.3.13 Changes that occurred during the last five years (Increased, Decreased, No change)

6.4. Ownership of trees

6.4.1 Have you got trees on land owned by you? (Y/N)

6.4.1.1 If yes, total number of trees

6.4.1.2 If yes, number of pine (coniferous)

6.4.1.3 If yes, number of non-pine (non-coniferous)

6.4.1.4 If yes, number of fodder tree species

6.4.1.5 If yes, number trees other than fodder tree species

6.4.2 During the last ten years, has there been any change in the number of trees in your land? (Decrease, Increase, Remains the same).

Annex 10

Principles, criteria and indicators for sustainable woodfuels and for sustainable charcoal production⁴⁸

Principles, criteria and indicators for sustainable woodfuels

[Where households gather or produce woodfuel themselves, household surveys may yield information on those indicators marked with a tick (✓).]

Principle 1. Policies, laws, institutional frameworks and capacity exist and are clear and consistent.

For effective governance, laws and policies specifically addressing woodfuels must be in place and must be consistent across the various levels of government and relevant institutions (e.g. those relating to energy and forestry). There must be sufficient institutional capacity within regions and operations to adequately implement and monitor such laws and policies.

CRITERION 1.1 Woodfuel production is consistent with international commitments and follows domestic laws.

Indicators

- Where governments have acceded to sustainable forest management or energy-related agreements at an international level, the existence of specific domestic laws and policies to support these commitments.
- The existence of specific laws and policies to provide for sustained woodfuel supply

⁴⁸ FAO. 2010. *Criteria and Indicators for Sustainable Woodfuels*. FAO Forestry Paper 160. FAO Publication: Rome.

CRITERION 1.2 Forest and energy policies address woodfuel issues.

Indicators

- The extent to which forest management policies recognize woodfuel production as one of the uses of forests and trees.
- The extent to which energy policies include components specific to woodfuels.

CRITERION 1.3 The instruments of woodfuel policies are consistent across and within ministries, agencies and levels of government.

Indicators

- The existence of mechanisms to ensure regular communication between forest and energy agencies to coordinate woodfuel policies.
- The extent to which the policies and laws administered by revenue, pollution control, industrial development, agriculture and other agencies are consistent with woodfuel policies.
- The extent to which applicable policies at the national, regional and local levels are consistent with each other.
- The extent to which local or traditional knowledge informs management planning and is consistent and compatible with national, regional and local policies.

CRITERION 1.4 Information on the status and use of woodfuel resources is available.

Indicators

- The extent to which accurate forest-cover and land-use data are available.
- The extent to which woodfuel production and consumption data are available.
- The extent to which data on the sale of woodfuels from public lands, including volumes and prices, are publicly available.
- The effectiveness of government monitoring and evaluation of national, regional and local programmes and initiatives affecting woodfuels.

CRITERION 1.5 The capacity to manage and regulate woodfuel production and consumption exists.

Indicators

- The extent to which national, regional and local agencies have the human and financial resources to implement existing policies and laws affecting woodfuels.
- The extent to which woodfuel producers are trained in sustainable woodfuel production practices.
- The extent to which programmes to sensitize stakeholders on the importance of sustainable woodfuel management are available.

Principle 2. Human and labour rights are respected and social and cultural values are maintained or enhanced.

Local people should benefit from woodfuel production, and the social and cultural values and the rights of local people should be respected. Criteria and indicators under this principle include requirements for the baseline assessment of existing social conditions so that strategies can be developed through stakeholder participation that will ensure social equity and provide opportunities for local people. Under this principle, woodfuel production should have no negative impacts on food security.

CRITERION 2.1 Land-use rights and ownership are clearly defined and established.

Indicators

- ✓ The extent to which stakeholder tenure rights are stated and acknowledged, and are secure.
- ✓ The existence of mechanisms for land acquisition, and the extent to which they are implemented.
- ✓ The existence of mechanisms for resolving disputes over land rights, and their effectiveness.

CRITERION 2.2 Woodfuel production is planned and implemented in a transparent and participatory manner involving all relevant stakeholders.

Indicators

- ✓ The existence of communication mechanisms for dialogue and conflict resolution between various stakeholders, and their effectiveness.
- ✓ The extent to which the needs of the population are taken into account by woodfuel producers.
- ✓ The extent to which there is equitable sharing of benefits.

CRITERION 2.3 Workers' wages and working conditions comply with all applicable laws, international conventions and collective agreements.

Indicators

- The extent to which woodfuel producers adhere to international labour conventions.
- The number of employees, contracted labour and small-scale producers/growers involved in woodfuel production.
- The nature of the salaries and benefits of employees in the woodfuel sector.
- The rates of injuries of employees in the woodfuel sector.

CRITERION 2.4 Woodfuel production contributes to the social and cultural development of local, rural and indigenous communities.

Indicators

- ✓ The extent of improvement in community access to energy.
- ✓ The extent of improvement in the economic conditions of communities.
- ✓ The extent of involvement and representation of stakeholders in decision-making processes involving woodfuel production.
- ✓ The extent to which programmes designed for women and marginalized communities are developed and implemented.
- ✓ The area and percentage of forests used for the purpose of supporting women and marginalized communities.

CRITERION 2.5 Woodfuel production minimizes negative impacts on food security.

Indicators

- ✓ The extent to which forest-dependent communities retain access to forest lands for food.
- ✓ The effect of management of the woodfuel resource on the density of species that are important sources of food.

Principle 3. Economic sustainability is ensured.

If woodfuel production is to be sustainable, the costs of producing woodfuels must not outweigh the benefits. Under this principle, the direct and indirect economic benefits of woodfuels should be maximized and long-term economic viability should be maintained.

CRITERION 3.1 Woodfuels represent the most beneficial use of woody biomass resources.

Indicators

- ✓ The extent to which the direct and indirect benefits of woodfuel production outweigh the direct and indirect costs.
- ✓ The efficiency with which woodfuels in particular and forest resources in general are used.

CRITERION 3.2 Woodfuels are economically viable.

Indicators

- ✓ The cost-competitiveness of woodfuels compared with alternative energy sources.
- ✓ The profitability of woodfuels, when the full benefits and costs are taken into account.

CRITERION 3.3 Woodfuels contribute to local/rural economic prosperity and the livelihoods of local residents.

Indicators

- The fairness of the distribution of income generated by woodfuel production among woodfuel producers and workers.
- The extent of employment opportunities, value-added products and credit facilities available to rural communities as a result of woodfuel production.
- The contribution of woodfuels to economic diversity and resilience.
- The accessibility and affordability of woodfuels to local residents.

Principle 4. Landscape and site productivity and environmental values are sustained.

This principle addresses the potential impact of woodfuel production systems on soils, hydrological systems, water quality, site productivity, biodiversity and GHG emissions.

CRITERION 4.1 Ecological resistance and resilience at the landscape level is maintained or enhanced.

Indicators

- ✓ The existence of measures to maintain or enhance diversity at the landscape and ecosystem levels.
- ✓ The extent of degradation of sensitive or valuable ecosystems, high-conservation-value forests, or protected areas.
- ✓ The long-term sustainability of harvest levels.
- ✓ The existence of long-term management strategies to sustainably meet user demand, and the extent to which they are being implemented.

CRITERION 4.2 Woodfuel production does not degrade ecosystems and landscapes.

Indicators

- ✓ The extent to which the productive capacity of ecosystems and landscapes, including forests, is maintained or improved.

- ✓ The extent to which practices ensure soil conservation and improvement.
- ✓ The extent to which soil nutrient status, temperature, structure and processes are maintained or improved.
- ✓ The extent to which the quality and quantity of surface and groundwater is maintained or improved.
- ✓ The extent to which, where necessary, reforestation is carried out to replace harvested forests.

CRITERION 4.3 Biodiversity is maintained or enhanced at the landscape level.

Indicators

- The extent to which sufficient habitat is maintained to ensure the survival of endangered forest-dependent species.
- The extent to which key habitats (e.g. cavity trees, downed woody debris, nesting sites and other niches) within managed areas are maintained.
- The extent to which there is connectivity between habitats in the landscape (e.g. migration corridors and the distribution of downed woody debris).
- The extent to which the conservation status of species is catalogued.
- The extent to which the population densities of threatened or endangered species are maintained.
- The extent to which negative ecological impacts from the use of genetically modified organisms are avoided.

CRITERION 4.4 Woodfuel production contributes to a net reduction in emissions.

Indicators

- The extent to which life-cycle carbon and greenhouse gas assessments are available and taken into consideration in management planning.
- The extent to which a supply chain energy balance is available and is taken into consideration in management planning.

Principles, criteria and indicators for sustainable charcoal production

[Households may be able to provide information on those indicators marked with a tick (✓). Households involved in charcoal production will undoubtedly be able to respond to other questions.]

Principle 1. Policies, laws, institutional frameworks and capacity exist and are clear and consistent.

CRITERION 1.1 Policy statements and legislation for charcoal production are established and implemented.

Indicators

- The existence of policy statements supporting charcoal production.
- The existence of laws governing charcoal production, and the extent to which their implementation is monitored.

CRITERION 1.2 Effective institutional structures exist to govern charcoal production.

Indicators

- The effectiveness of capacity-building mechanisms in place.
- The extent to which agencies (e.g. forestry, environment and/or energy) responsible for monitoring and assessing forests are equipped with the staffing and financial resources needed to fulfil their mandate.

Principle 2. Human and labour rights are respected and social and cultural values are maintained or enhanced.

CRITERION 2.1 The relationship between human culture and forest management and charcoal production is recognized and respected.

Indicators

- ✓ The extent to which charcoal production respects local cultures.
- ✓ The existence of activities that degrade human culture, and the effectiveness of measures to combat them.

CRITERION 2.2 The health impact of common charcoal-making technologies is addressed.

Indicators

- The level of health-related complaints and the cost of medication for charcoal makers, transporters and traders.
- The nature and quantities of the chemical constituents of smoke emitted from charcoal kilns/pits, including greenhouse gases such as carbon dioxide and methane, and health damaging emissions such as particulates and sulphur dioxide.

CRITERION 2.3 Livelihoods are improved through the sustainable production and consumption of charcoal.

Indicators

- The availability of and access to charcoal and other modern energy sources in rural areas.
- Employment generation from charcoal production activities in relation to total national employment.
- Average per capita income in various charcoal-production activities.

Principle 3. Economic sustainability is ensured.

CRITERION 3.1 There are adequate levels of investment in charcoal production, and the sector makes a commensurate contribution to economic growth.

Indicators

- The annual investment in sustainable resource management and charcoal production.
- The aggregate value of sustainable charcoal production and rate of return on investment in the sustainable production of charcoal compared with rates of return on investments in other sources of energy.

Principle 4. Landscape and site productivity and environmental values are sustained.

CRITERION 4.1 Biodiversity is conserved in natural and planted forests across all tenure types.

Indicators

- The extent to which the diversity of species harvested for charcoal is maintained.
- The existence of specific management measures to maintain biodiversity, such as the retention of seed trees and the protection of nesting sites and keystone species.

CRITERION 4.2 The ecosystem and protective functions of the forest are maintained.

Indicators

- The extent to which ecologically sensitive and important areas (e.g. plains, stream banks and steep slopes) are identified and protected with appropriate measures.
- The extent to which soil and water restoration programmes, where necessary, are implemented.

CRITERION 4.3 The boundaries of public charcoal resources are known and respected.

Indicators

- The extent to which local users and other stakeholders recognize and respect the boundaries of public wood energy resources (e.g. the existence of boundary markers and conditions of access).
- Evidence of forest encroachment (visual observation and records).

CRITERION 4.4 Effective local management is in place for maintaining, assessing and monitoring forest resources for charcoal production.

Indicators

- The extent to which ownership and use rights to resources are established and respected.

- The extent to which regulations governing forest resource use for charcoal production are enforced and monitored.
- The availability of documentation and records of forest activities related to charcoal production.
- The existence of conflict-resolution mechanisms (number of cases resolved).

CRITERION 4.5 Management plans are documented and implemented.

Indicators

- The adequacy of stated management objectives (both long-term and short-term).
- The existence of processes to revise forest management and harvesting plans periodically.

CRITERION 4.6 Local stakeholders are aware of the woodfuel resources available for charcoal production.

Indicator

- The extent to which local stakeholders involved in charcoal production meet and interact with resource managers.

CRITERION 4.7 Charcoal supply sources are managed sustainably.

Indicators

- The extent to which supply sources (i.e. natural forests, plantations, and trees outside forests) are under sustainable management.
- The legality of the fuelwood procurement system for charcoal-making, and the reliability of records on the volumes of woodfuel harvested and charcoal produced.

CRITERION 4.8 There are inventories of the charcoal-making technologies currently in use and assessments of their average efficiency.

Indicator

- The existence of a list of prevailing charcoal-making technologies and assessments of their efficiencies (e.g. record/report, fuelwood-input to charcoal-output ratio).

CRITERION 4.9 User-friendly and environmentally friendly charcoal-production technologies are promoted, and research and development is under way to improve the efficiency and effectiveness of woodfuel production and use.

Indicators

- The extent to which environmentally friendly charcoal-making technologies are promoted and applied.
- The extent to which priority areas for research and development in charcoal-making are identified (i.e. technologies and end-uses).

CRITERION 4.10 There are guidelines for charcoal quality control.

Indicator

- The existence of a guide or code on charcoal production (e.g. species selection, technology, reducing emissions, packaging, and labelling).

Annex 11

Approved VCS module VMD0008: estimation of baseline emission from forest degradation caused by extraction of wood for fuel

The following guidance on quantification of fuelwood consumption was extracted from the above document, which is available at <http://www.v-c-s.org/sites/v-c-s.org/files/VMD0008%20BL-DFW%20Fuelwood%20baseline.pdf>.

1. Quantify baseline consumption of fuelwood ($V_{BSL,FW,i,t}$): Baseline consumption of fuelwood shall be estimated by interviewing households or implementing a Participatory Rural Appraisal (PRA).

Sampling techniques can be used where multiple households/communities involved in fuelwood removal/charcoal production exist. Other sources of information, such as local studies on fuel-wood consumption and/or charcoal production can also be used. When using other sources of information, average data from a 5 to 10 years time period preceding the starting date of the project activity shall be used whenever possible.

Interviewees shall be asked to describe fuelwood consumption for their household and the number of people in the household. Mean consumption will be the household total divided by the number of people in the household. For charcoal production by teams or groups, the mean annual per capita production will be the total divided by the number of people in the production team.

It is unlikely that interviewed households will know their fuelwood consumption in terms of volumes of timber. Consequently verifiable measurements will be necessary to allow correlation between stated units (e.g. logs or trees) and volumes.

Mobile/commercial charcoal producers shall be considered separately from fuelwood collection for household use. In this case, estimates will be generated from interviews and official statistics to attain mean annual production of charcoal per producer.

The results from the interviews or PRAs must demonstrate that fuelwood collection and charcoal production in the project area are stable or increasing and are unlikely to decrease in the near future due to a lack of available stocks. If a decrease or likely future decrease are demonstrated, then the module cannot be used for baseline determination.

2. Enumerate the total population impacting or potentially impacting the project area

(TotPopn): The total population impacting or potentially impacting the project area shall be enumerated.

For mobile/commercial charcoal producers TotPopn should be equal to the number of producers impacting the project area in the baseline period. This number should either be enumerated directly or sampled statistically.