



Food and Agriculture Organization  
of the United Nations

# Guidelines for the Incorporation of a Woodfuel Supplementary Module into Existing Household Surveys in Developing Countries



# **Guidelines for the Incorporation of a Woodfuel Supplementary Module into Existing Household Surveys in Developing Countries**

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# Acronyms

<b>AFREC</b>	African Energy Commission of the African Union
<b>AFWC</b>	African Forestry and Wildlife Commission
<b>CAPI</b>	Computer-Assisted Personal Interviewing
<b>CFSVA</b>	Comprehensive Food Security and Vulnerability Analysis
<b>DHS</b>	Demographic and Health Surveys
<b>ECV</b>	Encuesta Condiciones de Vida
<b>EGM</b>	Expert Group Meeting
<b>EPICOMAD</b>	Encuesta Piloto Combustibles de Madera
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FAOLS</b>	FAO Lesotho
<b>GACC</b>	Global Alliance for Clean Cookstove
<b>GCV</b>	Gross Calorific Value
<b>GSARS</b>	Global Strategy to improve Agricultural and Rural Statistics
<b>HHV</b>	Higher Heating Value
<b>INEC</b>	Instituto Nacional de Estadística y Censos de Ecuador
<b>IRENA</b>	International Renewable Energy Agency
<b>ITTO</b>	International Tropical Timber Organization
<b>LBOS</b>	Lesotho Bureau of Statistics
<b>LFS</b>	Labour Force Surveys
<b>LHV</b>	Lower Heating Value
<b>LSMS</b>	Living Standard Measurement Study
<b>MICS</b>	Multiple Indicators Cluster Surveys
<b>MJ</b>	Mega Joule
<b>NGO</b>	Non-Governmental Organization
<b>NCV</b>	Net Calorific Value
<b>NSO</b>	National Statistical Office
<b>PAPI</b>	Paper-and-Pencil Interview
<b>SAC</b>	Scientific Advisory Committee
<b>SCM</b>	Solid Cubic Meter
<b>SDG</b>	Sustainable Development Goals
<b>SE4All</b>	Sustainable Energy for All Initiative
<b>STC</b>	Stacked Cubic Meter
<b>UNECE</b>	United Nations Economic Commission for Europe
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UNSD</b>	United Nations Statistics Division
<b>WHO</b>	World Health Organization
<b>WSM</b>	Woodfuel Supplementary Module

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# Introduction

## KEY MESSAGES

Woodfuel plays a critical role in the economic and social wellbeing of people around the world. Despite its role, many developing countries lack reliable data with which to estimate the patterns and trends of woodfuel consumption and production, leading to insufficient attention being given to wood energy in national policies and to problems in assessing its impact on health and the environment. These Guidelines present a tool, the Woodfuel Supplementary Module, which was designed to collect reliable and comparable data on woodfuel production and consumption across the world.



## 1.1 BACKGROUND

**Woodfuel**<sup>1</sup> plays a critical role in the economic and social wellbeing of people around the world. Approximately 2.4 billion people use woodfuel as their primary energy source for cooking, predominantly in developing countries (FAO, 2014)<sup>2</sup>. Indeed, fuelwood and charcoal are often the cheapest and most easily accessible source of energy in remote rural areas, where they enable the poor to meet their basic needs in the absence of other sources of energy.

Woodfuel is an important source of income and employment for rural households. There are, however, significant gender and social implications associated with its production and consumption. Women and children, for example, may spend several hours a day collecting fuelwood for domestic uses. This results in less time being available for other activities, such as education and child nurturing. Furthermore, women are most likely to suffer from smokes and emissions from the inefficient burning of wood with primitive stoves in unventilated kitchens (WHO, 2016).

The use of woodfuel, moreover, has significant and complex implications for the environment. Depending on the sustainability of its production and consumption, fuelwood and charcoal can be seen as a source of carbon-neutral renewable energy or as a driver of local forest degradation, deforestation and greenhouse gas emissions.

The provision of affordable and sustainable woodfuel and its improved use will contribute to the overall mission of poverty reduction and improve general human health and well-being in many developing countries. An important step towards this ultimate goal is to understand the magnitude and scale of its production and consumption. How much woodfuel is consumed each year, by whom, and for what purpose? Who is involved in the production of woodfuel, and to what extent? Where does the woodfuel mainly come from?

Despite the economic, social and environmental importance of woodfuel, many developing countries lack reliable data with which to estimate the patterns and trends of woodfuel consumption and production, and the labour associated with it<sup>3</sup>. Indeed, woodfuel is predominantly produced and traded in the informal sector<sup>4</sup>. This is an important source of income for the poor; however, reliable information upon it is seldom available.

As a result, the impact of woodfuel production on local economies and livelihoods are largely underestimated and ignored. This leads to insufficient attention being given to wood energy in national policies, strategies, and allocations of financial and human resources. The absence of reliable data on woodfuel production and consumption also hinders assessment of its impact on forests and the environment, and the formulation of effective policies for the woodfuel sector.

The costs associated with conducting a stand-alone national survey on woodfuel could be prohibitively high. Countries relying heavily on woodfuel for energy are often developing countries and thus lack the necessary resources to gather information on a regular basis. Therefore, most of the available data on the production and consumption of woodfuel in developing countries come from models or consumption-based secondary data; discrepancies between them are not uncommon.

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1 According to the Unified Bio-Energy Terminology (UBET), woodfuel is a subcategory of biofuels, which in turn constitute a subcategory of renewable energy sources (FAO, 2004). Biofuels comprise woodfuel, agrofuels and municipal by-products. As for woodfuel, this category includes solid, liquid and gaseous products. In this study, only solid woodfuel (fuelwood and charcoal) is considered, while black liquor, pyrolytic oil and other liquid and gaseous products are not taken into account. As for fuelwood, it includes: (i) wood in the rough; (ii) wood chips; (iii) wood residues; and (iv) pellets and briquettes. Based on the source of wood, fuelwood can also be divided into direct wood (from forests and non-forest land), indirect wood (from wood industry) and recovered wood (from society).

2 For a complete list of developing countries, see [https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESP2018\\_Full\\_Web-1.pdf](https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESP2018_Full_Web-1.pdf) (table C, p. 142).

3 Global Strategy, 2016 (chapter 3).

4 See annex 4 for a definition of the “Informal Sector”.

A limited amount of systematically collected field data is available. However, they are mostly based on small-scale surveys conducted at the level of individual villages, towns or regions. Different patterns of woodfuel production and consumption across local communities, bias in selection and the absence of a sound statistical sampling methodology often make it hard to extrapolate the results from local surveys to a regional or national scale. Accordingly, the results of these thematic studies cannot be used for cross-country comparisons and long-term trend assessments.

Conversely, a variety of national household surveys are conducted regularly in many developing countries and collect internationally comparable data on a wide array of topics. These surveys, however, often lack questions on the amount of woodfuel consumed and its source, and fail to address socio-economic and environmental issues associated with woodfuel production and consumption. Incorporating a woodfuel module into the questionnaire of those surveys could help national statisticians to gain better evidence on the socio-economic and environmental impact of woodfuel in a more cost-effective way.

## 1.2 OBJECTIVES AND SCOPE

One of the main objectives of the Action Plan of the Global Strategy<sup>5</sup> is the development of guidelines on how to formulate efficient and cost-effective methodologies that can be used by countries to support their decision-making processes. Within this framework, a collaboration between the Global Strategy to improve Agricultural and Rural Statistics (GSARS) and the FAO Forestry Department was launched in 2015.

The goal of the project titled “Developing a Woodfuel Supplementary Module for Incorporation into Existing Household Surveys in Developing Countries” – of which these guidelines are the final outcome – is to develop a tool, the Woodfuel Supplementary Module (WSM), to be incorporated in existing national household surveys. The ultimate goal is to enable countries to collect reliable and comparable data on woodfuel production and consumption.

The scope of the project is limited to capturing information on the production and consumption of woodfuel in the informal sector (which mostly corresponds to the household sector) as the data availability regarding other sectors is generally greater.

The main outcomes of the intermediate steps of the research are described in annex 1<sup>6</sup>. These Guidelines (i) introduce the final version of the WSM and (ii) discuss how to include it in the questionnaires of existing household surveys and derive indicators of consumption and production of woodfuel.

There is a pressing need for more information on the consumption of woodfuel in countries where it is the main fuel for the majority of households. As highlighted in the conclusions of the 20th African Forestry and Wildlife Commission (AFWC), the Commission has asked FAO: (i) to develop “...tools in support of policy formulation and decision-making processes...”, (ii) to address “...sustainability of woodfuel production...” and “...efficiency of charcoal making...”; and (iii) to “...make sustainable wood energy one of its priorities in Africa” (AFWC, 2016).

The development of the WSM is an initial step towards helping developing countries to gather accurate data on woodfuel production and consumption, the sustainability of its production, and related socio-economic and health outcomes. The target audience is the staff of national statistical offices and statisticians in charge of household surveys within such offices, as well as the ministries responsible for forestry and forestry research institutions. The expected outcome of the project is an improvement in the measurement and tracking of woodfuel production and consumption, as well as in national statistical capacity.

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5 Available at <http://www.fao.org/docrep/016/i3082e/i3082e.pdf> (accessed 31 May 2018).

6 The project included the following activities and outputs: (1) review of the existing literature on national woodfuel statistics in developing countries, survey-based woodfuel studies and international recommendations on woodfuel survey – Technical report 1 (Global Strategy, 2016); (2) review of current national surveys that could potentially incorporate the woodfuel module as a supplementary component – Technical Report 2 (Global Strategy, 2017a); (3) development of the WSM and proposal of a methodology on how to include the WSM into existing surveys, with suggestions on data analysis and other relevant issues; (4) organization of an Expert Meeting to discuss the WSM and the proposed methodology; (5) Finalization of the methodological proposal – Technical Report 3 (Global Strategy, 2017b) and organization of a field test in two pilot countries; (6) implementation of the field tests and writing of technical reports including the findings of the field tests (Global Strategy 2018a, 2018b and 2018c); (7) preparation of the Guidelines on how to incorporate a woodfuel module into existing surveys. The technical reports and working papers are all available at: [gsars.org/en/tag/forestry](http://gsars.org/en/tag/forestry)

A number of SDG targets<sup>7</sup> are linked with woodfuel production and consumption, among which:

- Target 3.9 – Reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination<sup>8</sup>
- Target 5.4 – Recognize and value unpaid domestic work<sup>9</sup>
- Target 7.1 – Ensure universal access to affordable, reliable and modern energy services<sup>10</sup>
- Target 7.2 – Increase the share of renewable energy in the global energy mix<sup>11</sup>
- Target 7.3 – Double the global rate of improvement in energy efficiency<sup>12</sup>
- Target 12.2 – Achieve sustainable management and efficient use of natural resources<sup>13</sup>
- Target 15.2 – Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally<sup>14</sup>.

The information collected with the WSM will contribute to inform these indicators, and will help policy-makers to gain a clearer idea of several elements, including: (i) the amount of woodfuel used by the household sector; (ii) the amount of time and money spent to acquire woodfuel; (iii) the amount of energy obtained from woodfuel by the household sector; (iv) the penetration of clean cooking and heating fuels and devices; (v) the seasons of the year when there is more scarcity of woodfuel; and (vi) the amount of fuelwood obtained from forests<sup>15</sup>.

The provision of reliable information on woodfuel consumption and production is envisaged to ultimately benefit the environment, the household sector, economic entities dealing with forests and woodfuel, and the livelihoods of forest-dependent people, through the improved availability and quality of data to be used in formulating evidence-based policies in the forest and agricultural sector.

The Guidelines are structured as follows. Section 2 describes the WSM, the proposed sampling strategy and the methodology to incorporate the module into the questionnaires of existing household surveys. Section 3 describes the indicators that can be derived from the data gathered through the WSM, the data dissemination strategies, the missing components of the WSM and the further steps required to enhance the module. The main outcomes of the previous steps of the project are presented in annex 1, while annexes 2 and 3 include the WSM and the Manual for Enumerators, respectively. A glossary of the main terms related to woodfuel is included in annex 4, while annex 5 presents some examples of flashcards that can be used by enumerators during the survey<sup>16</sup>.

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7 The complete list is available at: <https://unstats.un.org/sdgs/indicators/indicators-list/> (Accessed 4 April 2018).

8 Indicator 3.9.1: “Mortality rate attributed to household and ambient air pollution”.

9 Indicator 5.4.1 “Proportion of time spent on unpaid domestic and care work by sex, age and location”.

10 Indicator 7.1.2 “Proportion of population with primary reliance on clean fuels and technology”.

11 Indicator 7.2.1 “Renewable energy share in the total final energy consumption”.

12 Indicator 7.3.1 “Energy intensity measured in terms of primary energy and GDP”.

13 Indicator 12.2.2 “Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP”.

14 Indicator 15.2.1: “Progress towards sustainable forest management”.

15 This information is important for reforestation plans.

16 The flash cards in annex 5 are the same as those used by INEC for the field test in Ecuador.



# 2

## Data collection methods

### KEY MESSAGES

The WSM is designed to collect information on the consumption, acquisition, production and sales of woodfuel at the household level, through either Paper-And-Pen Interviewing (PAPI) or Computer-Assisted Personal Interviewing (CAPI). It comprises four main sections covering the following topics: fuelwood use, collection and sales; charcoal use, production and sales; cooking and heating; and health problems. The WSM is not meant to be a fixed set of questions to be included in all types of surveys, with the same modalities. Some surveys may only include the questions that are more relevant to the objectives of the survey, while others may include the entire set of the WSM questions. Even in the latter case, the module must be adapted to the visual design and the structure of the hosting questionnaire.

The statistical unit of the WSM is the household, intended as an independent user and producer of fuelwood and charcoal. The inclusion of the WSM into the survey questionnaire implies additional time and costs. Accordingly, an appropriately selected subsample of households will have to be extracted from the original sample of households, for inclusion of the WSM into the survey questionnaire. The sampling strategy, however, will be decided by the implementing agencies, based on the available sampling frames, the budget allocated to the survey, and the level of data accuracy and disaggregation required. As far as the WSM is concerned, the size of the subsample should enable deriving estimates at the national and rural-urban level. For countries – or areas – where the use of woodfuel is very low, oversampling techniques may be taken into account. The sampling strategy adopted must be taken into account when analysing the data collected.

Finally, when using the module in different countries, adapting the WSM to better reflect local conditions (for example: languages, names of stoves and kilns, etc.) should be considered.

The WSM is designed to collect information on the consumption, acquisition, production and sales of woodfuel – and the related socio-economic health and environmental implications – occurring in the informal sector<sup>1</sup>.

The aim is to gather nationally relevant and internationally comparable data through a set of standard questions to be included in existing household surveys. Its development is based on the main conclusions of the literature review on woodfuel studies (Global Strategy, 2016) according to which:

- the available data often cover only the primary type of household cooking fuel, and not the quantities of woodfuel consumed;
- the uses of woodfuel for purposes other than cooking<sup>2</sup> contributes significantly to global woodfuel consumption;
- woodfuel consumption rates should be derived from quantitative measurements carried out during the interview, rather than the interviewee's values;
- national socio-economic household surveys should include options for identifying secondary fuels or the mix of fuels used by households;
- the source of woody biomass should be recorded to identify the contributions of forestry, agriculture and industry;
- information such as labour inputs and health implications should also be collected, in addition to the quantity of woodfuel consumed;
- household consumption survey questionnaires should be as simple and brief as possible.

Further improvements on the WSM incorporated the suggestions of international experts and the indications drawn from the two field tests undertaken in Lesotho and Ecuador<sup>3</sup>.

The WSM described in section 2.1 and presented in annex 2 to these Guidelines is the Paper-and-Pencil Interview (PAPI) version developed with Microsoft Visio. Alternatively, a Computer-Assisted Personal Interview (CAPI) may be conducted, which uses tablets rather than paper questionnaires. The choice of data collection mode (PAPI or CAPI) depends on the country where the household survey is being implemented, the type of survey in which the WSM will be included, and the implementing agency<sup>4</sup>.

The Manual for Enumerators presented in annex 3 includes instructions on undertaking the interview, asking each question of the WSM and reporting the information provided by the respondents into the WSM. These are all key steps that must be considered if reliable data is to be gathered. In particular, the Manual provides detailed explanations on how to weigh woodfuel, how to estimate the volume of wood logs and how to measure wood moisture, which are among the key variables to be collected through the WSM<sup>5</sup>.

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1 For a definition of the term “informal sector”, see annex 4 (the glossary).

2 Space heating, other domestic, commercial, agricultural or other uses.

3 See Annex 1. The main outcomes of the field tests are described in Global Strategy 2018a, 2018b and 2018c.

4 More details on the type of interviewing can be found in par. 2.4.

5 By knowing quantities and moisture of wood, in fact, the amount of energy derived by households from woodfuel can be estimated. When quantities are too big to be measured, volume estimation is recommended; volumes can then be converted into quantities through density coefficient factors, which depend on the tree species used.

## 2.1 THE WOODFUEL SUPPLEMENTARY MODULE (WSM)

The WSM comprises a cover page and five main sections: Section 1 – Roster of Household Members; Section 2 – Fuelwood; Section 3 – Charcoal; Section 4 – Cooking and Heating; and Section 5 – Health Problems. The cover page and roster do not have to be included in the household survey questionnaires as proposed in these Guidelines, because each survey questionnaire has its own cover page and its own roster. As many WSM questions refer to the roster, however, it has been included to avoid confusion for the reader.

The WSM is not intended to be a fixed set of questions that must be included in all types of surveys according to the same modalities. Some surveys may include only the questions that are most relevant to the survey's objectives, while for others, it may be fitting to include the entire set of the WSM questions<sup>6</sup>. Even in the latter case, however, the WSM must be adapted to the visual design and structure of each questionnaire. Therefore, the approach followed here is a flexible one, which allows for variations in the flow of questions without affecting the comparability of the data gathered.

### Cover page and Section 1 – Household Roster

The cover page includes questions on the geographic location of the household<sup>7</sup> and the dwelling<sup>8</sup>, as well as on the household<sup>9</sup> and the responsible staff<sup>10</sup>.

Of particular importance is box C, titled “Household Information”, because choosing the right respondent is fundamental if reliable data on the consumption and production of woodfuel are to be collected. The respondent should be either the person responsible for the activity consuming most woodfuel (for example, the main cook) or the person responsible for the acquisition or collection of fuelwood, or the production of charcoal.

The household roster includes 12 lines, one for each household member, and seven columns, corresponding to seven questions to be asked for each member: 1. name(s) and last name(s); 2. sex; 3. age; 4. relationship to the household head; 5. whether they ate at home in the last seven days; 6. whether they slept at home in the last seven days; and 7. ethnic self-identification. The codes (1–12) on the left uniquely identify each household member and are used to match the answers of a number of questions in the following sections of the module.

Questions 2, 3 and 7 are particularly important to evaluate the socio-economic and health impacts of woodfuel consumption and production by age and sex class, and by ethnic group. Questions 5 and 6 aim to obtain the exact number of consumers of fuelwood over the reference period of fuelwood consumption (last seven days), with a view to estimate more precisely the per capita consumption of fuelwood<sup>11</sup>.

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6 See Global Strategy, 2017a; par. 2.11.

7 Box A: region, province, district, area, etc.

8 Box B: address, floor number, etc.

9 Box C: household number, name of respondent, date of interview, etc.

10 Box D: supervisor, enumerator, etc.

11 Some household members may not have eaten or slept at home during the reference period of the main variables; if unaccounted for, these absences might introduce bias in the per capita value of the variables of interest.



## Section 2 – Fuelwood

Sections 2 and 3 are divided into four subsections: A – Use; B – Acquisition; C – Collection/Production; and 4 – Sales. The “Use” subsections begin with a filter question with a “Yes/No” answer. A negative answer will trigger a skip pattern to the next subsection, hence reducing the number of questions to be answered and the burden on the respondent.

It is important to emphasize that a negative answer to the filter question of the “Use” section does not imply that the following subsections (for example, Acquisition of Fuelwood) should also be skipped: consumption and acquisition of woodfuel, in fact, do not necessarily occur in the same period (for example, fuelwood is purchased during the summer and consumed during the winter for space heating). Moreover, the recall period is different throughout the WSM, ranging from the “last 7 days” in Section 2.A – Use of fuelwood, to the “last 30 days” in Sections 3.A – Use of charcoal and 5. – Health Problems, and the “last 12 months” for all other sections.

The reason behind the choice of different recall periods lies in the different consumption and acquisition patterns relating to fuelwood and charcoal: while fuelwood is mostly consumed on a daily basis, charcoal is used less frequently by households<sup>12</sup>; as for acquisition, its frequency varies, from daily collection to yearly bulk purchases.

### Section 2.A – Use of fuelwood

If the answer to the filter question is affirmative, the respondent must provide information on: the number of days on which fuelwood was used in the last seven days (Q. 2); the usual amount of fuelwood consumed by the household in one day (Q. 3); the moisture of the wood used (Q. 4); the type(s) of uses of fuelwood (Q. 5); and the use that entails the greatest consumption of fuelwood (Q.6).

These questions enable key information to be derived, such as: the total (and per capita) weekly amount of wood consumed by the household; the total energy derived from fuelwood by the household; and the main purposes for which households use fuelwood. Quantities used for agricultural and commercial purposes should be accounted for only if those activities are not performed in the context of a business company having legal status (an incorporated company)<sup>13</sup> but fall within the informal sector, according to the definition provided in the glossary at annex 4.

Instructions on measuring quantities of fuelwood and moisture are provided in the Manual for Enumerators (see annex 3). It is important to note that quantities of fuelwood can be reported either in terms of weight (kg) or volume (m<sup>3</sup>); the quantities should refer to a single representative day of the past seven days, and include the amount used for all possible uses – domestic, commercial, agricultural, cultural or religious – provided that the non-domestic uses relate to “informal” activities, as per the definition of the informal sector. The quantities should refer to a single day because the quantity consumed over the entire week may be too large to measure with a spring scale<sup>14</sup>.

<sup>12</sup> In many cases, for example, only for barbecues during weekends.

<sup>13</sup> These quantities must be surveyed through Micro-Enterprise Surveys.

<sup>14</sup> For a thorough review of the methodologies available to measure the weight of fuelwood, see Global Strategy, 2017b.

Wood moisture – measured through specific hygrometers – is measured to derive the calorific value of wood, defined as the amount of energy per unit mass or volume released upon complete combustion<sup>15</sup>. In fact, the moisture content of wood decreases its calorific value, as part of the energy released during the combustion process is spent in water evaporation and is consequently not available for thermal uses<sup>16</sup>. It is therefore possible to define a Gross Calorific Value (GCV) or Higher Heating Value (HHV) and a Net Calorific Value (NCV) or Lower Heating Value (LHV). The latter is determined by subtracting the heat of vaporization of the water from the HHV. The net calorific value of oven-dry wood (NCV0) of different species varies within a very narrow interval, from 18.5 to 19 MJ per kg<sup>17</sup>. In conifers, it is 2 percent higher than in broad-leaved trees, due to the higher lignin content<sup>18</sup> and to the higher resin, wax and oil content of conifers (FAO, 2015b).

The most decisive factor for a high-energy yield is therefore water content, followed by wood type. For small heating systems (those of private houses or apartments), the water content of the woodfuel should not exceed 25 percent. If the wood has higher water content, then the temperatures would fall below the ideal range, which would lead to increased smoke formation, higher emissions and damage to the chimney<sup>19</sup>. During the seasoning of wood<sup>20</sup>, a 10-percent decrease in moisture entails an approximate 2.16 MJ (or 0.6 kWh) per kg increase in energy content (FAO, 2015b; see table 1).

**TABLE 2.1. EFFECT OF WOOD STORAGE ON CALORIFIC VALUE.**

Condition of wood	Water content (M)	Calorific value (H)
Fresh timber	50–60%	7.2 MJ/kg = 2.0 kWh/kg
Timber stored for one summer	25–35%	12.2 MJ/kg = 3.4 kWh/kg
Timber stored several years	15–25%	14.4 MJ/kg = 4.0 kWh/kg

Source: Wood Fuels Handbook (FAO, 2015b; p. 12).

**TABLE 2.2. AVERAGE VALUES USED FOR DIFFERENT TYPES OF FUELWOOD.**

NCV	Type of fuelwood	Moisture
NCV0 = 18.5 MJ/kg = 5.1 kWh/kg	Oven-dry wood	M 0%
NCV10 = 17.0 MJ/kg = 4.7 kWh/kg	Pellets	M 10%
NCV20 = 14.4 MJ/kg = 4.0 kWh/kg	Firewood	M 20%
NCV30 = 12.2 MJ/kg = 3.4 kWh/kg	Wood chips	M 30%

Source: Wood Fuels Handbook (FAO, 2015b; p. 12).

Knowing the moisture of wood used enables estimation of the amount of energy that the households derive from fuelwood.

<sup>15</sup> See FAO, 2015b; pp. 11–16.

<sup>16</sup> Water evaporation involves the “consumption” of 2.44 MJ per kg of water. To calculate the caloric value (MJ per kg) of wood with specific water content ( $w$ ), the following formula can be used:  $H_i = \frac{H_{10} \cdot (100 - w) - 2.44 \cdot w}{100}$ , with  $H_{10}$  varying between 18.5 MJ/kg and 19.0 MJ/kg (depending on the wood species) and  $w$  = water content (measured with a hygrometer) (FAO, 2015b).

<sup>17</sup> However, if agricultural biofuels are also taken into account, the anhydrous calorific value varies within an interval of 16.5 MJ per kg to 19 MJ per kg. The anhydrous calorific value of woodfuel is averagely 9 percent higher than that of herbaceous plants.

<sup>18</sup> Compared to cellulose and hemicellulose, lignin has a higher energy content.

<sup>19</sup> See FAO, 2015; p. 12.

<sup>20</sup> Questions on seasoning are not included in the current version of the WSM; however, they may be considered in the development of a long version of the WSM for stand-alone surveys.

### **Section 2.B – Acquisition of fuelwood**

This section investigates whether fuelwood was acquired over the last 12 months, the type of acquisition<sup>21</sup>, the frequency of acquisition, the amount acquired (purchased, collected, received, etc.) over the reported period and – only for purchased fuelwood – the amount of money spent. With the information gathered in Section 2.B, analysts can estimate the yearly household expenditure on fuelwood, the amount of fuelwood purchased or otherwise acquired, and the main way in which the household obtains fuelwood.

As opposed to the section on use, the section on the acquisition of fuelwood does not have a fixed reference period: respondents are asked whether they have acquired fuelwood during the last 12 months and, if so, they are asked for the frequency<sup>22</sup> of acquisition. Indeed, fuelwood is often acquired once or twice per year, and referring to the last seven or 30 days – as in the subsections on use – would cause a substantial loss of information.

### **Section 2.C – Collection of fuelwood**

The collection of fuelwood has important implications not only for households' livelihoods, but also on the time use of household members. Therefore, a specific subsection is dedicated to it, including questions on: the main source of the cut or collected wood; the time required to go to the main source, cut or collect the wood and return home; the household members involved in fuelwood collection; and the months of the year when fuelwood is scarce.

While the question on the source of wood is important to estimate the amount of wood actually removed from natural forests<sup>23</sup>, the two following questions – on the time devoted to fuelwood collection and the members involved – are useful to estimate the impact of fuelwood collection on the household members' time allocation, by age and gender class, and to estimate each member's contribution to (unpaid) domestic activities.

Finally, the question on wood scarcity sheds light on patterns in the availability of wood energy throughout the year. It thus provides inputs that may enable the identification of critical periods for household energy security. Such information is also useful to understand when it is necessary to intervene at the political or administrative levels.

### **Section 2.D – Fuelwood sold and given for free**

The last subsection of section 2 investigates whether households are involved in selling or donating woodfuel, the frequency of such sales or gifts, the amount of fuelwood sold or donated and the revenues obtained from sales over the reported period, enabling the estimation of – among other things – the yearly revenue obtained by households from fuelwood sales. The reason why a 12-month reference period was chosen is that sales of fuelwood, like acquisitions, may occur only once or twice a year; therefore, choosing a reference period of seven or 30 days would imply a substantial loss of information.

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21 Which should be one of the following: 1. Purchase; 2. Payment in-kind; 3. Barter; 4. Gift; and 5. Collection.

22 The options are: Daily, Weekly, Fortnightly, Monthly, Quarterly, Half-Yearly, Yearly, Other.

23 Not all cut or collected fuelwood comes from forests or forest plantations. It may also be obtained from own farm, construction sites, dumps, etc.

### Section 3 – Charcoal

The structure of section 3 is similar to that of section 2 on fuelwood: it is divided in four subsections – Use, Acquisition, Production and Sales – and includes most of the questions of section 2. The reference period of charcoal consumption, however, is the last 30 days. The results of the field tests showed that charcoal consumption occurs less frequently than fuelwood consumption; therefore, limiting the recall period to the last seven days would lead to a loss of information.

Other differences are the following:

- The question on moisture is omitted
- Section 3.C – Production of Charcoal includes specific questions relating to the charcoal production process:
  - the quantity of wood used to produce charcoal;
  - the main way of obtaining the wood;
  - the type of kiln used to produce charcoal;
  - the number of days (rather than hours) required to produce charcoal.

The quantity of wood used to produce charcoal is a fundamental parameter to estimate the wood-to-charcoal conversion factor. Such a coefficient is an indicator of the efficiency of the conversion of wood biomass into charcoal (expressed in terms of kg of wood burnt to produce 1 kg of charcoal), which in turn depends to a great extent on the type of kiln used. Indeed, while the efficiency of traditional kilns is low – causing serious deforestation where the production of charcoal is substantial – that of modern, improved kilns is much higher. The list of kilns will have to be adapted to the most-used types or models in the country under observation.

Another question investigates the household members involved in charcoal production, enabling evaluation of the socio-economic aspects of such activity, such as the time devoted to charcoal production by age class and gender.

It is to be noted, however, that legal restrictions on charcoal production – which are in place in a substantial number of countries across the world – might introduce bias in the respondents' answers, indeed constituting one of the largest sources of non-sampling errors.

### Section 4 – Cooking and heating

Section 4 comprises ten questions – five on cooking and five on heating – which investigate the following topics:

- Type of stove (or technology) used
- Type of heating system used
- Type of stove and heater used for most of the time.
- Main source of energy of the stoves and heaters used
- Location of the stoves and heaters
- Presence of windows, fans, chimneys in the cooking and heating areas

The type of stove and heater used is one of the most important parameters in estimating the efficiency of biomass combustion and of energy use. While the efficiency of traditional stoves and heaters is low – which increases both the consumption of biomass and the time required for its collection, and causes high levels of household air pollution – the efficiency of modern, improved appliances is much higher. The list of stoves and heaters should be tailored to the main models and types available in the country under observation<sup>24</sup>, taking into account the possibility that the same stove or technology used to cook is also the main source of energy for space heating<sup>25</sup>.

<sup>24</sup> Although the main types may already have been identified in the household survey questionnaire. In many countries, this information may be obtained from the ministry responsible for energy.

<sup>25</sup> Especially in remote rural areas, where electricity and gas are not always available or affordable.

The location of stoves and heaters is another important factor to be considered when analysing household air pollution. The combination of low-efficiency stoves and polluting fuels causes the emission of pollutants that negatively affect the health of household members – especially of those who spend more time cooking or near the stove, such as adult women and children. Exposure to household air pollution may be much higher in the absence of proper ventilation. There are five possible answer categories to the question on cooking location: 1. Indoors, in a dedicated kitchen. 2. Indoors, in a room also used for sleeping; 3. Indoors, in the living area; 4. In a separate building; 5. Outdoors. A subsequent question investigates the presence of windows, extractor hoods, chimneys, fans or other ventilation systems, which may help to reduce the concentration of indoor air pollutants.

Finally, knowing the main stove of the household is necessary to understand the energy and fuel consumption patterns of a household (for example, the consumption of woodfuel is low because the stove used most often is an electric stove).

### **Section 5 – Health problems**

The last section of the module explores the health problems arising from exposure to fuel combustion<sup>26</sup>. This section enables determination of whether exposure to higher polluting fuel/technology combinations result in health problems, which can further be classified by age group and sex.

One of the main difficulties relating to this section is that respondents are only required to mention those health problems that are directly related to household fuel combustion, thereby excluding all other possible illnesses or accidents that have occurred at home and are not related to fuel combustion, smoke, indoor pollution, etc<sup>27</sup>. For this reason, the phrasing of the question specifies that the health problems must result from exposure to fuel combustion.

Additional questions may be asked on the type of health problems suffered by each household member<sup>28</sup>, although this would remarkably increase the length of the module and thus the time required to answer its questions.

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26 Not only woodfuel, but all possible fuels used by the household, to be consistent with other health surveys undertaken by WHO.

27 These mistakes were common during the field test.

28 For example: headache, skin or eye irritations, and breathing problems. These questions were included in the two versions of the WSM tested in the field.

## 2.2 HOW TO INCORPORATE THE WSM INTO EXISTING SURVEY QUESTIONNAIRES

As mentioned above, the approach to be followed when including the WSM into existing questionnaires is flexible, allowing for variations in the flow of questions without the comparability of the gathered data being affected. This is because every type of survey has its own structure, flow of questions and priorities, which makes it difficult to design a single version of the module that will fit all questionnaires. This section provides an example of how to incorporate the WSM into the questionnaire of the *Ecuadorean Encuesta de Condiciones de Vida* (ECV; Living Standard Survey): a comprehensive household survey that has been conducted for several years<sup>29</sup>. For a detailed description of how to incorporate the WSM into the questionnaires of other types of survey, see Global Strategy (2017b).

The questionnaire of the sixth round of the ECV 2013–14<sup>30</sup> already included some questions related to woodfuel consumption and household fuel combustion:

- In section 1, part A, “Characteristics of the dwelling”, questions are asked about the type of fuel used for cooking – wood/charcoal is one of the answer categories – and the type of kitchen;
- In section 10, part B, “Monthly expenditure”, expenditure on wood and charcoal are queried.
- In section 13, part C, “Forestry activities”, questions 1 to 4 enquire upon the value of the sales of wood cut by the household, and the estimated monetary value of self-consumed wood.

Some sections of the questionnaire did not include questions that specifically related to woodfuel, but rather enquired upon socio-economic aspects that are also queried in the WSM:

- Section 3, part C: questions about health and illnesses for all household members;
- Section 4: time use;
- Section 5, part B: reasons for not attending school;
- Section 12, part C: fuels used for the household’s commercial activities.

The questions of the WSM could thus be introduced into the ECV questionnaire as follows:

- Questions on the consumption of fuelwood (quantity, moisture) and charcoal can be introduced in section 1-A (Characteristics of the dwelling), after question 13 about cooking;
- Questions about stoves and heaters can also be introduced in section 1-A to complement the information collected through the current questions. Alternatively, they may be added to section 10-D (Equipment).
- Questions on purchases of fuelwood and charcoal can be introduced in section 10-A (Expenditure), subsection IV (non-food expenditures).
- Questions on the collection and sales of fuelwood and on the production and sales of charcoal can be incorporated in section 13-C (Forestry activities), along with questions on the source of wood.
- Questions about the consequences of household fuel combustion on household health may be added to sections 3-B and 3-C (Presence of illnesses).
- Questions on wood scarcity, finally, may be inserted into section 10-A, after the questions of subsection III (Food security).

Another possible approach is to introduce the entire set of questions of the WSM into a single module. Alternatively, questions on the quantities of woodfuel consumed and the type of stoves and heaters used could be included in a one-page module, and other questions (for example, on health) could be included in the relevant sections of the survey questionnaire.

<sup>29</sup> It is to be noted that the module tested in Ecuador was not incorporated into the ECV because the ECV’s timing did not coincide with the schedule of the field test.

<sup>30</sup> Available at: [http://www.ecuadorencifras.gob.ec/documentos/web-inec/ECV/ECV\\_2015/documentos/Metodologia/Formulario%20ECV%206R.PDF](http://www.ecuadorencifras.gob.ec/documentos/web-inec/ECV/ECV_2015/documentos/Metodologia/Formulario%20ECV%206R.PDF) (accessed 1 June 2018).

## 2.3 SAMPLING STRATEGY

As discussed at the beginning of section 2 of these Guidelines, the statistical unit of the WSM is the household, defined as a “group of persons who make common provision of food, shelter and other essentials for living” (UN, 2017; annex 4). Each household is intended as an independent user and producer of fuelwood and charcoal<sup>31</sup>.

The coverage should extend to all households in a country, without establishing thresholds that exclude households contributing little to total woodfuel consumption and production. This means, for example, that both rural and urban households should be part of the sampling frame and, if the WSM is incorporated into the questionnaire of an agricultural survey focusing exclusively on rural areas, a complementary survey may be carried out in urban areas<sup>32</sup>.

The sampling strategy – including the survey sample size – will be decided by the implementing national agencies, based on the available sample frames, the budget allocated to the survey, and the level of data accuracy and disaggregation required. Measuring woodfuel quantities, however, requires the purchase, transport and use of scales, training of interviewers, longer survey questionnaires, and hence additional interviewing time and implementation costs. Accordingly, an appropriately selected subsample of households should be extracted from the sample of households of the main survey for inclusion of the WSM into the survey questionnaire.

In the case of two-stage stratified cluster sampling based on a list or area frame – the most common sampling strategy adopted by the surveys that could incorporate the WSM<sup>33</sup>, which implies the selection of enumeration areas (or villages) in the first stage and of households within the selected areas in the second stage – the proposed sampling strategy is the following: a fixed proportion of the sampled households in selected clusters receives the WSM within the survey questionnaire. The subsample is selected with simple random sampling; the proportion chosen in each domain depends on the subsample’s necessary size and on the size of the main survey sample.

For each domain, the minimum required sample size ( $n$ ) of the subsample is obtained with the following formula:

$$n = \frac{D z^2 p (1-p)}{d^2}$$

where:

$D$  = Design effect;

$z$  =  $z$ -score corresponding to the chosen degree of confidence<sup>34</sup>;

$p$  = Estimated proportion of the key indicator (share of households using woodfuel) expressed as a decimal<sup>35</sup>;

$d$  = Maximum tolerable error (or: minimum desired precision), expressed in decimal form<sup>36</sup>.

31 Based on the definition of the informal sector presented in the glossary at annex 4, which includes: “(...) household enterprises or, equivalently, unincorporated enterprises owned by households”.

32 For a thorough discussion on the types of survey that could incorporate the WSM, see Global Strategy (2017a).

33 See Global Strategy (2017a).

34 1.96 for a degree of confidence of 95 percent; 2.576 for a degree of confidence of 99 percent.

35 For example, 20 percent = 0.20.

36 For example,  $\pm 5\% = .05$ . Precision refers to the degree of error around the estimate (absolute sampling error) resulting from the fact that the estimate is based on a sample.



The Design effect ( $D$ ,  $D_{eff}$ , or  $deff$ ) can be defined as the number of times by which the minimum sample size should be multiplied to obtain the same level of precision obtained with a simple random sample (for which  $D = 1$ ). The lower the number of households per cluster, the less pronounced the  $D$  eff and the higher the precision of estimates will be. This is because elementary units within clusters tend to exhibit some degree of homogeneity. Increasing the number of clusters and decreasing the size of each cluster is a preferable option, as it decreases the  $D$  eff with a constraint sample size. The  $D$  eff is often assumed to be equal to 2; however, it actually varies by type of sampling and by indicator, and can only be computed ex post (WFP, 2009)<sup>37</sup>.

The value of  $p$  would correspond to the estimated share of households consuming woodfuel in a given country, whenever this estimate can be obtained from previous surveys or woodfuel studies<sup>38</sup>. When no reasonably accurate estimate may be found, a default value of 50 percent should be used, as it will yield the larger sample size.

As for the value of  $d$ , Bittermann and Suvorov (2012) state that in woodfuel surveys, it should not exceed  $\pm 3$  percent.

The minimum required sample size should be calculated for each domain, namely for each geographic stratum for which an estimate will be produced in the final report. This should be carefully considered when planning the survey, as an increase in the number of domains results in an increase in the minimum required sample size. As far as the WSM is concerned, a rural-urban stratification is deemed sufficient for analytical purposes. Deriving significant woodfuel statistics for geographic aggregations lower than urban and rural areas would be the ideal situation; however, this would entail more interviews and hence increased costs.

For example, assuming a  $D_{eff}$  equal to 2, a  $z$ -score of 1.96, an estimated share of households consuming woodfuel of 40 percent in the rural areas and of 15 percent in the urban areas of a given country, and a maximum tolerable error of  $\pm 3$  percent, the minimum required sample size would be 2 049 households in rural areas and 1 088 households in urban areas, for a total of 3 137 sampled households in the entire country. If, for example, the sample selected for the household survey includes 12 000 households<sup>39</sup>, of which half are in urban areas and half are in rural areas, then approximately one in three households in rural areas, and approximately one in six households in urban areas, will receive the WSM within the survey questionnaire.

It is worth noting that, because woodfuel consumption is affected by climatic conditions, the subsample should include clusters from different regions and elevation classes and – if the survey period elapses along an entire year – households should be surveyed in different seasons to take seasonality into account.

The final sample size is also affected by nonresponse. If, for instance, a 90-percent rate of response is expected<sup>40</sup>, then the sample size will have to be adjusted by an adjustment factor of  $1/0.9 = 1.11$  (Tango International, 2007). With reference to the example shown above, this implies a final sample size of  $3\,137 * 1.11 = 3\,482$  households.

37 Assuming a constant sample size, the  $D$  eff is influenced by the number of observations in each cluster and the intra-cluster correlation. A higher number of clusters, each small in size, results in a lower  $D$  eff, although it should be recalled that the  $D$  eff should be calculated for each indicator.

38 For a review of the surveys and censuses that already include questions on woodfuel consumption, see annexes 4–8 of Global Strategy (2017a).

39 Which is not far from the average sample size of surveys such as the Demographic and Health Survey (DHS), the Living Standards Measurement Study (LSMS), etc.

40 For example, because of respondent absence, inability to complete the interview, or refusal to participate in the survey.



For countries – or areas – with a very low prevalence of use of woodfuel, oversampling techniques might be taken into account, using agricultural or population censuses as sampling frames (see Global Strategy, 2017a; par. 2.4). Such techniques imply the creation of a sample with a higher share of households using woodfuel – compared to the original population – based on the information available from previous censuses or surveys. Questions on the main type of fuel used for cooking, for example, are included in most population censuses. Such information can be used to identify the households that use woodfuel in areas with a low rate of adoption of this source of energy.

Finally, the sampling strategy adopted must be taken into account when analysing the data collected. One of the most important effects of a sampling design is the need to weigh the results to compensate for the unequal probabilities of a household being included in the sample and to extrapolate the results to the entire population of interest (WFP, 2009)<sup>41</sup>. Failing to account for sample weights would lead to wrong conclusions about the parameters of interest to the survey (UNSD, 2005b). Therefore, special statistical software packages that take full account of the complex nature of the sample design should be used when analysing the survey data.

## 2.4 DATA COLLECTION MODE, DURATION OF INTERVIEW, TIMING AND LOCAL ADAPTATIONS

The main data collection modes are shown in table 2.3. Face-to-face interviews carried out by professional enumerators remain the best means of quality data collection (Global Strategy, 2017). To improve the quality and timeliness of data, the use of CAPI technologies is recommended.

**TABLE 2.3. STANDARD DATA COLLECTION MODE.**

Technology	Type of administration	
	Interviewer administration	Self-administration
CAPI	CAPI, CATI*	CASI**; WBS (or CAWI)***; EMS****.
PAPI	PAPI face-to-face interview	PAPI mail surveys

\* Computer-Assisted Telephone Interviewing;

\*\* Computer-Assisted Self-Interviewing;

\*\*\* Web-Based Survey (or Computer-Assisted Web-Interviewing);

\*\*\*\* E-Mail Surveys.

Source: Author's elaborations on Brancato et al. (2006).

41 Design weights can be defined as the inverse of the probability that a household will be selected, or the number of households represented by each sampled household in a substratum, according to the following formula:  $W_s = N_s/n_s$ , where  $W_s$  is the design weight in a sampling stratum  $s$ ;  $N_s$  is the total number of households in the sampling stratum  $s$ ; and  $N_s$  is the sample size of the sampling stratum  $s$ . If, for example, the same number of households is sampled in all strata but each stratum has a different population, the weights must be “normalized” to correct for this unequal sampling probability across strata. This is to be done as follows:  $w_s = (N_s/N)/(n_s/n)$ , where  $w_s$  is the normalized weight for a sampling stratum  $s$ ;  $N_s/N$  is the proportion of all households living in sampling stratum  $s$ ; and  $n_s/n$  is the proportion of sampled households coming from stratum  $s$ . Accordingly, if the proportion of sampled households coming from stratum  $s$  – the denominator in the above formula – is (for example) greater than the proportion of the total population living in the same stratum – the numerator – then the normalized weight  $w_s$  assumes a value lower than 1 (and vice versa). Multiplying this value by the design weight, the weighed number of households for each stratum is obtained. These weights can then be used to obtain estimates at the population, rather than the sample, level.

According to Caeyers, Chalmers and De Weerd (2012), CAPI interviewing allows for a substantial reduction of errors compared to PAPI. As for the costs of the computer-assisted options, the prices of the required tablets start at about USD 60. Moreover, tablets allow for collecting Global Positioning System (GPS) information, which is fundamental when performing spatial analyses and taking photographs. Portable wireless scales – with which data on wood and charcoal weight may be collected – can also be connected to the device.

As far as the WSM is concerned, the data collection mode depends on the specific survey in which the module is to be incorporated. As the questionnaire design is affected by the data collection mode, different versions must be designed for each type of interview. Annex 2 to these Guidelines includes the PAPI version of the module.

A CAPI module can be developed with the help of software such as Survey Solutions<sup>42</sup>, Collect Mobile<sup>43</sup> or CSPro<sup>44</sup>.

Another important aspect is the amount of time required to ask the additional questions relating to the WSM. This is one of the most important parameters to consider in a survey, as the increased number of questions entails an additional burden on respondents and, above all, further costs for the implementing agency. The estimated amount of time required to ask all of the WSM questions presented in annex 2 is approximately 13 minutes, including the time necessary for weighing wood and charcoal. However, it is to be noted that whenever some sections can be omitted, the time required for asking the WSM questions will decrease accordingly.

As for the timing for data collection, it should be considered that seasonality is a key dimension in woodfuel production and consumption, especially for space heating. Ideally, each household should be surveyed twice a year – once in the cold season and once in the hot season – to obtain a more precise idea of the consumption patterns. Alternatively, as suggested in section 2.3, the subsample should include households surveyed in different seasons, provided that the survey period is sufficiently long to cover all possible seasons. The timing, however (as well as other methodological aspects such as the type of interview) will depend on the survey that will incorporate the module.

When using the WSM in different countries, adaptations should be taken in consideration to better reflect local conditions. First, when translating the module into different languages, it is necessary to ensure the cross-national harmonization of questions. To carry out functionally equivalent translations, two independent draft translations per language should be made, and a pre-test should be an integral part of the translation process (Brancato *et al.*, 2006).

Moreover, in some countries, the questionnaire should be developed in more than one language because of the presence of significant minorities with their own languages<sup>45</sup>. For an overview of the official and main languages spoken in developing countries, see Global Strategy (2017b; annex 10).

Other adaptations regard the names of stoves and kilns: given the wide variety of stoves and kilns available globally<sup>46</sup>, only a small number of them is listed in the WSM. The selection will depend on the country under observation and will be based on both literature reviews and interviews of key informants, work to be completed prior to the implementation of the survey.

42 Developed by the World Bank and available at <https://solutions.worldbank.org/account/login?ReturnUrl=%2f> (accessed 4 April 2018). The data collected through the tablet can be exported in the most frequently used formats that are compatible with software for data analysis, and it is possible to upload photos and metadata (Rahija, 2016). It also features a support website that provides users with instructions and video tutorials.

43 Developed by FAO and available at <http://www.openforis.org/tools/collect.html> (accessed 4 April 2018). Collect Mobile is a data collection tool based on the Android operating system that enables the completion of complex data structures. It is also integrated with the Collect software (a tool for survey design and data management) and enables the export of data into commonly used formats.

44 Available at: <https://census.gov/data/software/cspro.html> (accessed 15 June 2018).

45 During the field test in Ecuador, for example, interviews conducted in remote mountainous areas and in the Ecuadorean Amazon required the presence of an interpreter, as the respondents did not understand Spanish.

46 For charcoal kilns, see, for example, Kammen and Lew (2005) and Smith *et al.* (1999).

With regard to cooking stoves, the Global Alliance for Clean Cookstoves (GACC) lists over 400 different types of stoves in its Clean cooking catalogue<sup>47</sup>. Other studies on stoves used in different countries are listed in Global Strategy (2017b; annex 8).

The list included in the WSM will therefore have to be adapted to local conditions. To facilitate respondents' selection of the correct type of stove, "flashcards" similar to those prepared by the National Institute of Statistics of Ecuador (INEC) for the field test conducted in Ecuador can be provided to enumerators (see annex 5). For the CAPI data collection, pictures of stoves and kilns can be shown to respondents on the enumerator's tablet.

With regard to the plant species used as fuel<sup>48</sup>, the only way to identify a plant species is by its scientific name. However, this is often unknown to the vast majority of respondents, and several local names may correspond to the same scientific name of a given plant, even within the same region of a country, making it somewhat complicated for analysts to identify the plant used. For this study, the wood species is asked for with an open question, without any pre-coded answer. Respondents are asked to provide the local name of trees, which is "translated" into the respective scientific names by the enumerator, based on information obtained through interviews to key informants prior to the implementation of the survey.

Finally, local adaptations are required with regard to the months of the year and local currencies<sup>49</sup>.

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47 Available at <http://catalog.cleancookstoves.org/stoves> (accessed 15 June 2018).

48 This information is necessary to convert the volume of logs into weight (in kg) through conversion factors that depend on the wood species.

49 In Nepal, for instance, where the Hindu Vikram Samvat calendar is adopted, the number of months in a year can change over time.

# 3

## Woodfuel indicators, data dissemination and data gaps

### KEY MESSAGES

Data on the consumption, acquisition, production and sales of woodfuel by the household and the informal sectors are often missing from countries' responses to the questionnaires administered by international organizations. The data gathered through the WSM is envisaged to address this data gap.

This section presents the indicators that can be built using the data gathered through the WSM.

Some indicators of the SDG framework can also be partially informed with the WSM data.

To ensure that the information collected through the WSM reaches the greatest possible number of users, the statistical organizations involved and their partners should have a concise and efficient dissemination program, which should be guided by the basic principles described in this section. Depending on the priorities and statistical needs of each country, the data and indicators collected by the WSM can be presented in three main ways: tables, graphs and maps.

In all cases, estimates should be presented with their associated sampling error (at least for the main variables of interest) and its potential impact on the interpretation of the results and on any policy decisions that may be based on such an interpretation.

In addition, the aspects of household consumption and production of woodfuel that are either partly covered or not covered by the WSM are also addressed in this section. Suggestions on how to further improve the methodology are also proposed.

### 3.1. WOODFUEL INDICATORS

The WSM described in the previous section aims to fill the data gaps identified in the literature review on woodfuel studies (Global Strategy, 2016), through the collection of data on, among other aspects, quantities of woodfuel produced and consumed for cooking and other domestic and non-domestic purposes, the source of woodfuel, the labour and health implications of its production and consumption, and secondary fuels.

The information gathered through the WSM will allow for the following indicators to be built:

#### Use, acquisition, collection and sales of fuelwood

- Share of households using fuelwood, by area (Urban/Rural), gender of head and ethnic group
- Share of households using fuelwood, by type of use
- Share of households using fuelwood, by type of acquisition
- Quantity of fuelwood used by the household sector, by household size and area (Urban/Rural)
- Total amount of energy obtained from fuelwood by the household sector, by area (Urban/Rural)<sup>1</sup>
- Household average monthly expenditure on fuelwood (in local currency), by area (Urban/Rural)
- Consumer price of fuelwood, by area (Urban/Rural)
- Quantity of fuelwood cut or collected by the household sector, by source of collection
- Time spent collecting fuelwood, by area (Urban/Rural), sex and age
- Number of months per year when fuelwood is unavailable, by area (Urban/Rural)<sup>2</sup>
- Share of households selling fuelwood, by area (Urban/Rural)
- Quantity of fuelwood sold by the household sector, by area (Urban/Rural)
- Average household monthly income derived from fuelwood sales, by area (Urban/Rural)
- Producer price of fuelwood, by area (Urban/Rural)

#### Use, acquisition, production and sales of charcoal

- Share of households using charcoal, by area (Urban/Rural)
- Share of households using charcoal, by type of use
- Share of households using charcoal, by type of acquisition
- Quantity of charcoal used by the household sector, by household size and area (Urban/Rural)
- Total amount of energy obtained from charcoal by the household sector, by area (Urban/Rural)<sup>3</sup>
- Household average monthly expenditure on charcoal (in local currency), by area (Urban/Rural)
- Consumer price of charcoal, by area (Urban/Rural)
- Quantity of charcoal produced by the household sector, by type of kiln
- Quantity of wood used to produce charcoal, by type of acquisition<sup>4</sup>
- Wood-to-charcoal ratio (efficiency of charcoal production: quantity of wood biomass used to produce a unit quantity of charcoal), by type of kiln<sup>5</sup>
- Time spent producing charcoal, by area (Urban/Rural), sex and age
- Share of households selling charcoal, by area (Urban/Rural)
- Quantity of charcoal sold by the household sector, by area (Urban/Rural)

1 To calculate this indicator, which is useful to SDG Indicator 7.2.1, it is necessary to know both the quantity and moisture of wood used by the households. To convert quantities of wood into energy values, see tables 2.1 and 2.2 in para. 2.1.

2 This information is useful to policy-makers. Indeed, the availability of woodfuel is fundamental to household food security in many developing countries.

3 See SDG Indicator 7.2.1.

4 Knowing the source of wood allows for a more precise estimate of the impact of charcoal production on forests.

5 Woodfuel is a renewable and climate-friendly form of energy if it is produced sustainably and used efficiently. However, in many developing countries, its conversion and utilization efficiency is far below the technical potential, particularly in terms of wood-to-charcoal conversion. Upgrading the conversion efficiency through the use of improved stoves and kilns could result in a large saving of wood for the same amount of charcoal (or energy) produced, and consequently reduce the demand for wood from forests and trees outside forests.

- Average household monthly income derived from charcoal sales, by area (Urban/Rural)
- Producer price of charcoal, by area (Urban/Rural)

### **Cooking and heating**

- Types of cooking stove used by the household sector, by area (Urban/Rural)
- Types of stove used as main stove by the household sector, by area (Urban/Rural)
- Share of households using clean fuels and technology for cooking<sup>6</sup>
- Types of heaters used by the household sector, by area (Urban/Rural)
- Types of heaters used as main heating appliances by the household sector, by area (Urban/Rural)
- Share of households using clean fuels and technology for space heating
- Quantity of woodfuel consumed by type of stove/heater used
- Share of households by location of stoves and heaters, and by presence of windows, hoods and chimneys in the cooking and heating places<sup>7</sup>
- Share of population who suffered from health problems due to fuel combustion at home, by area (Urban/Rural), sex and age

Additional indicators can be built matching the information collected through the WSM with data obtained through other sections of the hosting survey questionnaire, such as:

- Share of expenditure on fuelwood and charcoal on total household expenditure
- Share of income from fuelwood and charcoal sales on total income
- Woodfuel consumption by income deciles

Value chain analyses can also be performed by comparing, for instance, the average producer price and consumer price of fuelwood and charcoal in urban and rural areas.

Other indicators can be built on the basis of the information collected at the community level<sup>8</sup>, such as the type of tenure of forest areas where wood is cut or collected and charcoal is produced, the legal aspects of charcoal production, and the occurrence of deforestation because of woodfuel production. These aspects are not covered by the current version of the WSM, and can be considered in further developments (see section 3.3).

The data collected through the WSM will also contribute to the monitoring of a number of SDG targets. Table 3.1 below shows the questions of the WSM that provide useful information in this regard.

<sup>6</sup> See SDG Indicator 7.1.2. Inefficient combustion of woodfuel with traditional stoves and heaters in houses without windows or extractor hoods results in household air pollution and low efficiency for thermal applications. While advanced wood-burning stoves have reached a thermal efficiency of more than 70 percent, three-stone fires with a thermal efficiency of less than 20 percent are still widely used in many African countries (AFWC, 2016).

<sup>7</sup> Studies have proven the existence of a correlation between respiratory illnesses and the absence of a separate kitchen or windows, extractor hoods and chimneys (see, for example, O’ Sullivan and Barnes, 2007; p. 19).

<sup>8</sup> Provided that the survey questionnaire includes a “community” module.

**TABLE 3.1. CONTRIBUTION OF THE WSM TOWARDS THE MONITORING OF THE SDGS.**

SDG Indicator	WSM Question
<b>5.4.1</b> Proportion of time spent on unpaid domestic and care work, by sex, age and location	Time spent by household members on fuelwood collection and charcoal production.
<b>7.1.2</b> Proportion of population with primary reliance on clean fuels and technology	Types of cooking stoves and heating appliances used, and main fuel used to feed them.
<b>7.2.1</b> Renewable energy share in the total final energy consumption	Types of cooking stoves and heating appliances used, and main fuel used to feed them. Quantity (and moisture) of fuelwood and charcoal used by households.
<b>8.4.1</b> Material footprint, material footprint per capita	Quantity of fuelwood and charcoal used by the household sector. Quantity of wood used to produce charcoal (wood-to-charcoal ratio). Type of charcoal kiln.
<b>12.2.2</b> Domestic material consumption, domestic material consumption per capita	Quantity of fuelwood and charcoal used by the household.

## 3.2 DISSEMINATION OF RESULTS

As discussed in the Introduction, the incorporation of the WSM into the questionnaire of existing household surveys aims to improve and strengthen national socio-economic, environmental and health statistics on the production and consumption of woodfuel occurring at the household level, and to inform some indicators of the SDG framework.

A number of international organizations collect and disseminate data on the consumption and production of primary wood products worldwide. However, data on the production and consumption of woodfuel by the household and informal sectors are often missing from countries' responses to the questionnaires administered by international organizations. The data gathered through the WSM is envisaged to address this data gap. The following section includes a non-exhaustive list of organizations that could benefit from the incorporation of the WSM into national household surveys.

Since the 1990s, a partnership between the FAO Forestry Department<sup>9</sup>, the International Tropical Timber Organization (ITTO)<sup>10</sup>, Eurostat<sup>11</sup> and the United Nations Economic Commission for Europe (UNECE)<sup>12</sup> has been reporting international data on the production and trade of wood products, with the Joint Forest Sector Questionnaire<sup>13</sup>. Statistics cover wood products that are used as sources of energy: fuelwood, charcoal, chips, wood processing residues, pellets and briquettes<sup>14</sup>. The data collected through the WSM will enable countries to include, in their reported quantities, also those produced by the informal sector.

The International Renewable Energy Agency (IRENA) reports the amount of energy obtained from different sources of renewable energy by country<sup>15</sup>. The information on quantities of woodfuel and moisture of wood gathered through the WSM is crucial to determine such an amount.

Every year, the International Energy Agency (IEA) publishes a number of publications on energy statistics, including statistics on renewables<sup>16</sup>. Recent efforts have been made to build a database of energy efficiency in African countries, in collaboration with the African Energy Commission (AFREC)<sup>17</sup>. To build such data sets, countries are required to collect data on the consumption of biofuels by the household sector and on the production of charcoal.

The United Nations Statistics Division (UNSD) produces the Energy Statistics Yearbook<sup>18</sup>, which contains information on the production of biofuels and wastes by country. In this case too, using the WSM to collect data on the production of fuelwood and charcoal by the household sector will help countries to obtain a more accurate picture of total production.

The World Health Organization (WHO) is the custodial agency for SDG indicator 7.1.2 and will report on the use of clean fuels and technologies. Section 4 of the WSM will contribute to the collection of data on the fuels and technologies used by households.

Other potential beneficiaries are the international agencies and organizations responsible for monitoring the achievement of the SDGs mentioned in the Introduction to these Guidelines, although some of them may have already developed their own version of the questionnaire to collect relevant data<sup>19</sup>.

Other international organizations or initiatives that disseminate data on topics covered by the WSM – such as the type of cooking technology adopted – include the GACC<sup>20</sup> and Sustainable Energy for All (SE4All)<sup>21</sup>. The information collected through the WSM can also be useful in emergency contexts to estimate the amount of fuelwood removed from forests surrounding emergency camps (FAO, 2018).

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9 <http://www.fao.org/forestry/statistics/en/>

10 [www.itto.int](http://www.itto.int)

11 <http://ec.europa.eu/eurostat>

12 <http://www.unece.org/forests/welcome.html>

13 <http://www.fao.org/forestry/statistics/80572/en/>

14 For data by country, see the *FAO Yearbook of Forest Products* (available at <http://www.fao.org/forestry/statistics/80570/en/>) and the *FAOSTAT-Forestry database* (<http://www.fao.org/faostat/en/#data/FO>).

15 <http://resourceirena.irena.org/gateway/dashboard/>

16 <http://www.iea.org/statistics/>

17 <http://afrec-energy.org/En/>

18 <https://unstats.un.org/unsd/energy/yearbook/2015/t12.pdf>

19 For example, questionnaires have been developed by the WHO and the Energy Sector Management Assistance Program (ESMAP) of the World Bank; the latter has also developed a Global Tracking Framework in this context.

20 <http://cleancookstoves.org/>

21 <https://www.seforall.org/>



As for national-level organizations, the potential array of users of the information collected through the WSM is wide: policy-makers who work on energy, forest and rural issues, poverty, the environment and public health; scholars in the academic sector; trade and producers' associations; Non-Governmental Organizations (NGOs); and the general public. One of the main ways to disseminate WSM data at the national and international levels is their publication on the websites of National Statistical Offices (NSOs) and international agencies, or in publications such as statistical yearbooks and thematic bulletins. In addition, dissemination alliances can also be formed with other national agencies that might be involved in the collection or analysis of WSM data, such as ministries of rural affairs, the environment or health.

To ensure that the information collected through the WSM reaches the maximum possible number of users, the statistical organizations involved and their partners should establish a concise and efficient dissemination program, which could be guided by the following basic principles:

- Definition of a publication calendar
- Publication of the information in a timely manner, according to the publication calendar
- Preservation of the confidentiality of the informant in the dissemination of information (anonymization)
- Preservation, as far as possible, of equality in accessing information for different types of users
- Ensuring the objectivity of the disseminated data
- Archiving of the data and relative metadata according to international standards<sup>22</sup>, to provide users with adequate information on the concepts and processes underlying the production of the published data sets

Depending on each country's priorities and statistical needs, the data and indicators collected by the WSM can be presented in three main ways: tables, graphs and maps<sup>23</sup>.

Tabulation is the most widespread method for disseminating data. The tabulation process requires the variables to be broken down into a limited number of classes and categories that can be conveniently displayed in statistical tables, based on the priorities of the statistical agency or the information needs of the country. For example, in the case of WSM data, the share of households using fuelwood and charcoal can be presented as follows<sup>24</sup>:

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22 See, for instance, <http://www.ihsn.org/archiving>

23 Besides anonymized raw data.

24 When presenting energy consumption statistics, they are usually divided into the following end uses: industry; transport; commercial and public services; residential; and other (agricultural, forest, and fishery sectors). The uses tabulated above would therefore account for the residential sector, the commercial sector and other uses.

**TABLE 3.2. SHARE OF HOUSEHOLDS USING FUELWOOD AND CHARCOAL OF TOTAL NUMBER OF HOUSEHOLDS, BY TYPE OF USE AND SOURCE (NATIONAL; URBAN-RURAL).**

	National (%)	Urban (%)	Rural (%)
<b>Fuelwood</b>			
<b>Use</b>			
Cooking			
Space Heating			
Other domestic uses			
Agricultural uses			
Commercial uses			
Cultural/religious uses			
<b>Source</b>			
Purchase only			
Collection only			
Gift, payment in-kind			
Other			
<b>Charcoal</b>			
<b>Use</b>			
Cooking			
Space Heating			
Other domestic uses			
Agricultural uses			
Commercial uses			
Cultural/religious uses			
<b>Source</b>			
Purchase only			
Collection only			
Gift, payment in-kind			
Other			

Alternatively, the data may be presented through graphs and maps. Graphs enable synthesis of a large amount of information and its display in a visual, direct and immediate manner. The most appropriate type of graph to present a variable or an indicator depends, among other things, on the nature of the variable and the purpose of the visualization.

As for maps, these allow for spatial representation of the most relevant data at regional, national and subnational levels, although they require a greater expenditure of time and resources<sup>25</sup>.

<sup>25</sup> As opposed to maps, the release of anonymized raw data does not involve such a great amount of time and resources, while at the same time allowing researchers from all over the world to engage in further analysis on the basis of the survey data.

In all cases, estimates should be presented together with their associated sampling error – at least for the main variables of interest – and its potential impact on the interpretation of the results and on the policy decisions that may derive from such interpretation (UNSD, 2005a)<sup>26</sup>. Sampling errors may be presented in three different forms: (a) as absolute values of standard errors; (b) as relative standard errors (squared roots of relative variances); and (c) as confidence intervals (UNSD, 2005b)<sup>27</sup>. The choice depends on the nature of the estimate. In general, absolute standard errors are easier to understand and to relate to the estimate, especially in the case of percentages, proportions and rates.

Finally, in some circumstances, non-sampling errors may have a greater impact on data quality than sampling errors. It is therefore recommended to include a discussion of the main sources<sup>28</sup> of non-sampling errors and a qualitative assessment of their impact on data quality. For example, the answer to certain sensitive questions – such as the production of charcoal in areas where it cannot be legally produced – may fail to reflect the real situation, as respondents may provide an “appropriate answer” rather than the true answer to the question.

### 3.3 DATA NOT CAPTURED BY THE WSM; STEPS FORWARD

The WSM introduced in these Guidelines covers several key aspects of woodfuel consumption, acquisition, production and sales – quantities, expenditure, time, revenues – and of the use of cooking and heating devices by the household sector.

Other aspects, such as the sustainability of woodfuel production and the impact of fuel combustion on household members' health, are covered only in part.

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26 For large-scale national surveys with numerous variables, domains of interest, and several – often competing – objectives, it is not practical to present each and every estimate with its associated sampling error. It is more useful to present sampling error information for a limited number of the most important characteristics of interest upfront and relegate the rest to an appendix (UNSD, 2005b).

27 Using confidence intervals requires the choice of a confidence level (for example, 90, 95 or 99 percent), that should be explicitly specified. In practice, the most frequently used interval is a 95 percent confidence interval: Estimate  $\pm 1.96 \times$  Standard Error (the probability that the true value of an indicator is within  $\pm 2e$  from its sampling estimate is approximately 95 percent).

28 Among which: a. incomplete or wrong identification of sampling units; b. inappropriate methods of interview, observation or measurement using ambiguous questionnaires, definitions or instructions; c. lack of trained and experienced field interviewers, including lack of good-quality field supervision; d. inadequate scrutiny of basic data to correct obvious mistakes; e. errors in data processing operations (coding, keying, verification, tabulation, etc.); f. errors during presentation and publication of tabulated results.

The WSM does not cover type of fuelwood used, seasoning of fuelwood (length, location) and a number of other topics, including:

- source of purchased wood (direct or indirect wood)
- buyers of sold woodfuel (households, retailers, industrial plants, etc.)
- legal restrictions on charcoal production (in the community questionnaire)
- time elapsing between woodcutting and charcoal production
- time between two consecutive harvests
- type of woodcutting (clear-felling or selective cutting)
- whether trees are planted to recover the cut trees (in the community questionnaire)
- distance (in km) to the main collection or production area (in the community questionnaire; this would allow for spatial analyses and application of the WISDOM model<sup>29</sup>)
- type of tenure of forest areas where wood is cut or collected and charcoal produced (in the community questionnaire)
- occurrence (and causes) of deforestation (in the community questionnaire)
- surface area heated
- number of hours spent cooking, by household member
- number and type of meals cooked at home per day
- types of health problems suffered because of fuel combustion, by household member
- activities affected by woodfuel shortages (cooking, space heating, etc.)
- self-evaluation of the household's energy portfolio (happy/unhappy) and of the most needed improvements (type of fuel/energy source)

Inclusion of these topics would excessively increase the length of the module and, therefore, respondent burden. These are among the main risks to avoid, as concluded also in the literature review on woodfuel studies (Global Strategy, 2016). The consequent reduction in the amount of available information is outweighed by the greater likelihood that a more agile tool will be incorporated into existing survey questionnaires. The development of a longer version of the WSM with additional questions (and the community module) could be considered for future stand-alone woodfuel surveys, based on the needs of (and demand in) interested countries.

These Guidelines describe the English PAPI version of the WSM. To further improve the proposed methodology, NSOs can also consider developing the CAPI version of the module using software packages such as Survey Solutions, Collect or CSPro. The possibility of connecting electronic scales and gas sensors<sup>30</sup> to the tablets used for CAPI procedures is another aspect worthy of testing. The WSM will also have to be translated in other official and local languages, and tailored to local contexts.

Finally, further research efforts could be directed towards testing alternative methods with which to weigh woodfuel, and comparing the variability of results<sup>31</sup>.

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<sup>29</sup> Woodfuel Integrated Supply/Demand Overview Mapping.

<sup>30</sup> Gas sensors can be connected to the tablet to estimate indoor air quality and the presence of pollutants, such as carbon monoxide.

<sup>31</sup> Among those listed in Global Strategy (2017b; chapter 2).



# References

- African Forestry and Wildlife Commission.** 2016. *Enhancing Sustainability and Efficiency of Woodfuel Production and Consumption*. Available at: <http://www.fao.org/3/a-mp516e.pdf>. Accessed 13 March 2018.
- Bittermann, W. & Suvorov, M.** 2012. *Quality Standard for statistics on wood fuel consumption of households*. Available at: [http://www.ca-res.eu/fileadmin/cares/public/Reports/Quality\\_standard\\_for\\_statistics\\_-\\_CA-RES\\_I/Quality\\_Standard.pdf](http://www.ca-res.eu/fileadmin/cares/public/Reports/Quality_standard_for_statistics_-_CA-RES_I/Quality_Standard.pdf). Accessed 23 April 2017.
- Brancato, G., Macchia, S., Murgia, M., Signore, M., Simeoni, G., Blanke, K., Körner, T., Nimmergut, A., Lima, P., Paulino, R. & Hoffmeyer-Zlotnik, J.H.P.** 2006. *Handbook of Recommended Practices for Questionnaire Development and Testing in the European Statistical System*. Available at: [http://www.istat.it/it/files/2013/12/Handbook\\_questionnaire\\_development\\_2006.pdf](http://www.istat.it/it/files/2013/12/Handbook_questionnaire_development_2006.pdf). Accessed 20 April 2018.
- Caeyers, B., Chalmers, N. & De Weerd, J.** 2012. Improving Consumption Measurement and Other Survey Data through CAPI: Evidence from a Randomized Experiment. *Journal of Development Economics*: 98, 19–33.
- Food and Agriculture Organization of the United Nations (FAO).** 2004. *UBET: Unified Bioenergy Terminology*. FAO: Rome. Available at: <http://www.fao.org/docrep/007/j4504E/j4504E00.HTM>. Accessed 6 March 2018.
- FAO.** 2014. *State of the World's Forests 2014*. FAO: Rome.
- FAO.** 2015a. *World Programme for the Census of Agriculture 2020. Volume 1: Programme, Concepts and Definitions*. FAO: Rome. Available at: <http://www.fao.org/3/a-i4913e.pdf>. Accessed 13 March 2018.
- FAO.** 2015b *Wood Fuels Handbook*. Author: Krajnc N. FAO: Pristina. Available at: <http://large.stanford.edu/courses/2017/ph240/timcheck1/docs/fao-krajnc-2015.pdf>. Accessed 13 June 2018.
- FAO.** 2018. *The Impact of Disasters and Crises on Agriculture and Food Security*. FAO: Rome. Available at: <http://www.fao.org/3/I8656EN/i8656en.pdf>. Accessed 18 April 2018.
- Global Strategy to improve Agricultural and Rural Statistics (Global Strategy).** 2016. *National statistics related to woodfuel production and consumption in developing countries, survey-based woodfuel studies, and international recommendations on woodfuel surveys*. Author: Broadhead, J. Global Strategy Technical Report No. 17: Rome. Available at: <http://gsars.org/en/tag/forestry/>. Accessed 6 March 2018.
- Global Strategy.** 2017a. *Review of national surveys and censuses that could incorporate a woodfuel supplementary module*. Author: Borlizzi, A. Global Strategy Technical Report No. 18: Rome. Available at: <http://gsars.org/en/tag/forestry>. Accessed 6 March 2018.
- Global Strategy.** 2017b. *How to Include the Woodfuel Supplementary Module into Existing Surveys and Derive Woodfuel Indicators*. Author: Borlizzi, A. Global Strategy Technical Report no. 26: Rome. Available at: <http://gsars.org/en/tag/forestry>. Accessed 6 March 2018.

**Global Strategy.** 2017. *Handbook on the Agricultural Integrated Survey (AGRIS)*. Available at <http://gsars.org/en/tag/agris/>. Accessed 20 April 2018.

**Global Strategy.** 2018a. *Field Test Report 1 – Lesotho*. Author: Borlizzi, A. Working Paper no. 20. Global Strategy Working Paper: Rome. Available at: <http://gsars.org/en/tag/forestry>. Accessed 6 March 2018.

**Global Strategy.** 2018b. *Informe Final de la Prueba Cognitiva Realizada en Ecuador*. Authors: Artieda Espinosa, C.; Carrasco Sumba, M.; Encalada Sandoval, E.; Hidalgo Aguilera, N.; Marín Luna, I. & Mier Sánchez, G. Global Strategy Working Paper no. 21: Rome. Available at: <http://gsars.org/en/tag/forestry>. Accessed 6 March 2018.

**Global Strategy.** 2018c. *Informe final Encuesta Piloto de Combustibles de Madera – EPICOMAD*. Authors: Artieda Espinosa, C.; Borlizzi, A.; Carrasco Sumba, M.; Madrid Arroyo, M.; Marín Luna, I. & Obando, C. Global Strategy Working Paper no. 22: Rome. Available at: <http://gsars.org/en/tag/forestry>. Accessed 12 March 2018.

**Instituto Nacional de Estadísticas y Censos (INEC).** 2013. *Cuestionario de la Encuesta Condiciones de Vida, Sexta Ronda – 2013-14*. INEC: Quito. Available at: [www.ecuadorencifras.gob.ec/documentos/web-inec/ECV/ECV\\_2015/documentos/Metodologia/Formulario%20ECV%206R.PDF](http://www.ecuadorencifras.gob.ec/documentos/web-inec/ECV/ECV_2015/documentos/Metodologia/Formulario%20ECV%206R.PDF). Accessed 13 June 2018.

**Kammen, D.M. & Lew, D.J.** 2005. *Review of Technologies for the Production and Use of Charcoal. Renewable and Appropriate Energy Laboratory Report*. University of California: Berkeley, CA, USA.

**O’Sullivan, K., Barnes, F.** (2007). *Energy Policies and Multitopic Household Surveys. Guidelines for Questionnaire Design in Living Standards Measurement Studies*. World Bank Working Paper No. 90. World Bank: Washington D.C.

**Rahija, M. A.** 2016. *Using Innovative Data Collection Tools in Agricultural Surveys*. Paper presented at the Global Strategy Training and Outreach Workshop on Agricultural Survey, 24–25 October 2016. Rome

**Smith, K.R., Pennise, D., Khummongkol, P., Chaiwong, V., Ritgeen, K., Zhang, J., Panyathanya, W., Rasmussen, R.A. & Khalil, M.** 1999. *Greenhouse Gases from Small-Scale Combustion Devices in Developing Countries: Charcoal-Making Kilns in Thailand*. Report prepared for the United States Environmental Protection Agency (USEPA). Available at: <http://www.bioenergylists.org/stovesdoc/Smith/kilns.htm>. Accessed 5 July 2018.

**Tango International.** 2007. *Monitoring and Evaluation Manual*. Available at: [http://www.fsnnetwork.org/sites/default/files/adra\\_me\\_manual.pdf](http://www.fsnnetwork.org/sites/default/files/adra_me_manual.pdf). Tango International: Tucson, AZ, USA. Accessed 24 April 2018.

**United Nations (UN).** 2000. *Household Accounting: Experience in Concepts and Compilation. Vol. 1: Household Sector Accounts*. Available at: [http://unstats.un.org/unsd/publication/SeriesF/SeriesF\\_75v1E.pdf](http://unstats.un.org/unsd/publication/SeriesF/SeriesF_75v1E.pdf) and <http://unstats.un.org/unsd/nationalaccount/pubsDB.asp?pType=2>. UN: New York, NY, USA. Accessed 8 March 2018.

**UN.** 2015. *Principles and Recommendations for Population and Housing Censuses – Rev. 3*. Available at: [http://unstats.un.org/unsd/demographic/meetings/egm/NewYork/2014/P&R\\_Revision3.pdf](http://unstats.un.org/unsd/demographic/meetings/egm/NewYork/2014/P&R_Revision3.pdf). UN: New York, NY, USA. Accessed 13 March 2018.

**UN.** 2017. *Household Size and Composition Around the World 2017*. Available at: [http://www.un.org/en/development/desa/population/publications/pdf/ageing/household\\_size\\_and\\_composition\\_around\\_the\\_world\\_2017\\_data\\_booklet.pdf](http://www.un.org/en/development/desa/population/publications/pdf/ageing/household_size_and_composition_around_the_world_2017_data_booklet.pdf). UN: New York, NY, USA. Accessed 29 May 2018.

**United Nations Statistics Division (UNSD).** 2005a. *Household Sample Surveys in Developing and Transition Countries*. Studies in Methods, Series F No. 96. UN: New York, NY, USA. Available at: [http://unstats.un.org/unsd/hhsurveys/pdf/Household\\_surveys.pdf](http://unstats.un.org/unsd/hhsurveys/pdf/Household_surveys.pdf) . Accessed 9 November 2016.

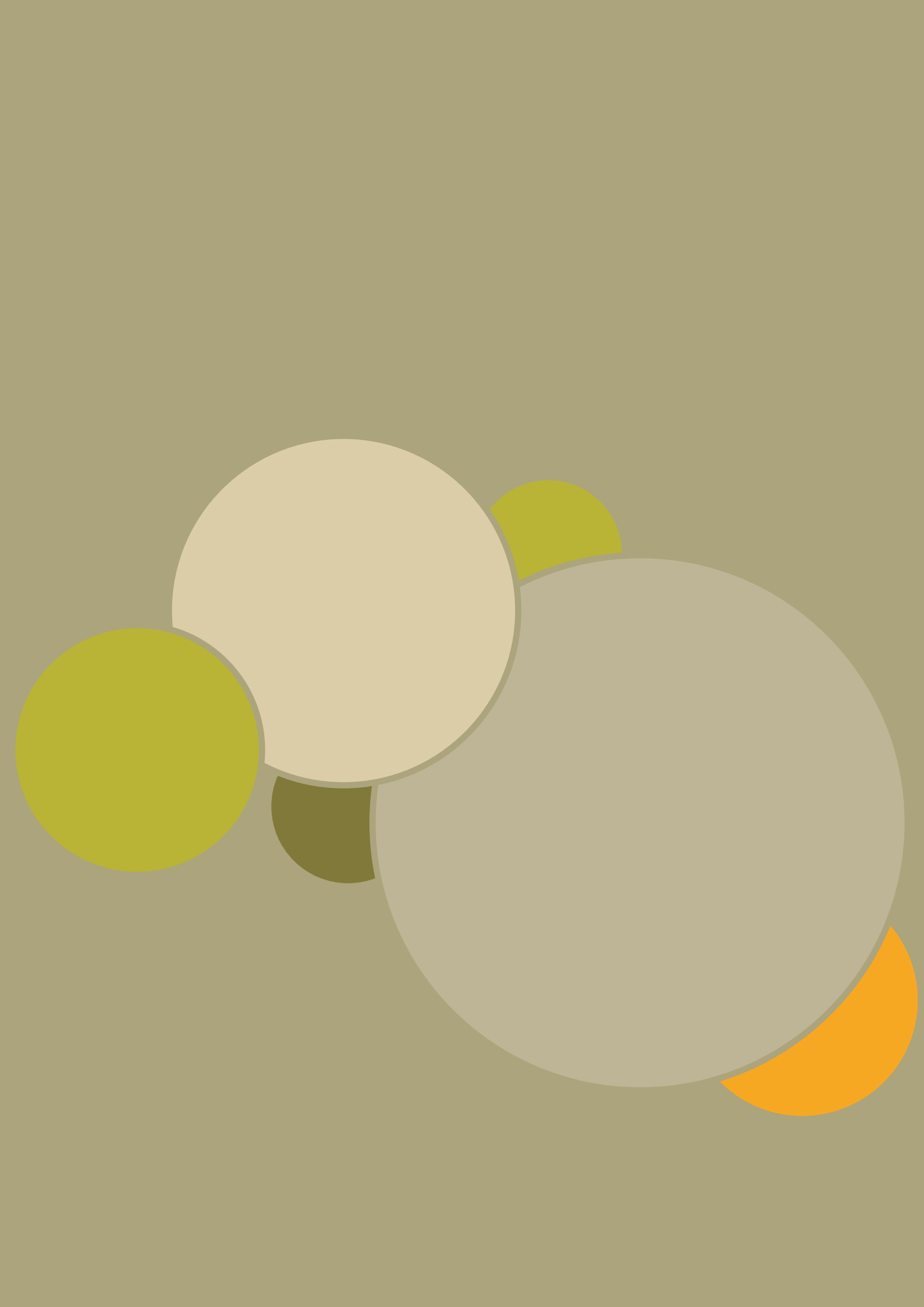
**UNSD.** 2005b. *Designing Household Survey Samples: Practical Guidelines*. Studies in Methods, Series F No. 98. UN: New York, NY, USA.

**World Bank.** 2017. *The use of non-standard units for the collection of food quantities*. LSMS Guidebook, July 2017. Available at: [http://siteresources.worldbank.org/INTLSMS/Resources/3358986-1423600559701/LSMS\\_GB\\_NSU\\_Web.pdf](http://siteresources.worldbank.org/INTLSMS/Resources/3358986-1423600559701/LSMS_GB_NSU_Web.pdf). Accessed 5 July 2018.

**World Food Programme (WFP).** 2009. *Comprehensive Food Security & Vulnerability Analysis. Guidelines*. WFP: Rome. Available at: [http://documents.wfp.org/stellent/groups/public/documents/manual\\_guide\\_proced/wfp203208.pdf](http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp203208.pdf). Accessed 23 April 2018.

**World Health Organization (WHO).** 2016. *Burning Opportunity: Clean Household Energy for Health, Sustainable Development, and Wellbeing of Women and Children*. WHO: Geneva, Switzerland. Available at: [http://apps.who.int/iris/bitstream/handle/10665/204717/9789241565233\\_eng.pdf;jsessionid=1B09308B77924EE22D2067823CA55AF8?sequence=1](http://apps.who.int/iris/bitstream/handle/10665/204717/9789241565233_eng.pdf;jsessionid=1B09308B77924EE22D2067823CA55AF8?sequence=1). Accessed 28 May 2018.





# Annex 1

## Main outcomes of the previous steps of the project

The main conclusions of the **literature review** on national woodfuel statistics in developing countries, survey-based woodfuel studies and international recommendations on woodfuel survey (step 1 of the project; see Global Strategy, 2016) were the following:

- The available data often cover only the primary type of household cooking fuel, but not the quantities of woodfuel consumed; a woodfuel module is necessary to determine the latter.
- The uses of woodfuel for purposes other than cooking contributes significantly to global woodfuel consumption.
- Woodfuel consumption rates should be derived from quantitative measurements carried out during the interview, rather than from the interviewee's values.
- National socio-economic household surveys should include options for identifying secondary fuels or the mix of fuels used by households.
- The source of woody biomass should be recorded to identify the contributions of forestry, agriculture and industry.
- Information such as labour inputs and health implications should be collected in addition to the quantity of woodfuel consumed.
- Household consumption survey questionnaires should be as simple and brief as possible.

Drawing on these recommendations, **Technical Report 2** (Global Strategy, 2017a) analysed existing surveys and censuses – and the questions on woodfuel included therein – to identify data gaps and the surveys and censuses more suitable for inclusion of a WSM. Its main conclusions are listed below.

- The introduction of a WSM into the questionnaires of population censuses would not be advisable, as many questions would fall outside their scope. The best approach would be to introduce a smaller set of questions about the use of wood energy, based on the recommendations included in United Nations (2015). Census data could then be used for building sampling frames for following woodfuel surveys.
- The same approach could be adopted for the Censuses of Agriculture 2020, by including in the census questionnaires all Essential items, Frame items and Additional Items related to woodfuel among those listed in FAO (2015a). The gathered information will then be used to establish sampling frames for later surveys.
- Inclusion of a WSM is recommended in the questionnaires of Multiple Indicator Cluster Survey (MICS), Demographic and Health Survey (DHS), Living Standard Measurement Study (LSMS), Labour Force Survey (LFS), Comprehensive Food Security and Vulnerability Analysis (CFSVA) and other national household surveys, although only LSMS, CFSVAs and national household surveys are likely to include the entire module. For MICS, DHS and LFS, on the other hand, inclusion of a reduced version of the module – containing only questions on woodfuel related to their “core business” – may be advisable.

**Technical Report 3** (FAO, 2017b) introduces the short and long versions of the proposed WSM, describes its sections<sup>1</sup> and questions, discusses how to incorporate the WSM into the questionnaires of existing household surveys, and presents indicators that can be built based on the data gathered through the WSM.

Among the main methodological issues discussed are: the weighing of woodfuel; the choice of the units of measurement and recall period; local adaptations of the module; data collection modes (PAPI or CAPI); and sampling.

The report includes the main suggestions collected during the **Expert Consultation** held at FAO headquarters in April 2017. Some of these suggestions are listed below.

- Cleaner types of woodfuel, such as pellets and briquettes, should be disaggregated from the general category of “fuelwood”, to collect data on them.
- It is important to capture not only the “main” cook stove and heating system, but also the secondary technologies and fuels adopted by households.
- It is difficult to capture the quantities of used woodfuel by single use: respondents may not know how to disaggregate quantities, and there may also be overlap among different uses.
- Non-standard units could be used, to avoid the need to weigh wood.
- It could be useful to survey the gender of the children collecting wood, to obtain disaggregated statistics on the involvement of boys and girls.
- Spring scales should be calibrated daily with a reference weight to obtain reliable measurements.
- It is important to quantify the amount of wood removed from forests, especially in light of the Paris Agreement.

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1 Household Roster; 2. Fuelwood; 3. Charcoal; 4. Cooking and Heating; 5. Health problems; 6. Woodfuel shortages.

Other useful suggestions were also provided by the members of the SAC of the Global Strategy. The main suggestions are listed below.

- Quantities of woodfuel can be indirectly estimated by collecting data on expenditure and prices. Small-scale experiments on the weight conversions from local units or local terms could also be done, instead of asking each household to weigh woodfuel in a large survey.
- The reference period for collecting the quantity used by households should provide multiple choices, to reflect the habits of different households. If a single recall period were to be selected, it should be shorter than the one proposed. Also, seasonality should be considered in determining the recall period. It could be useful to have two reference periods — a typical day in the summer and a typical day in the winter.
- There are questions on whether the sample size of the survey is adequate for computing woodfuel indicators, as the subsample using woodfuel could be small. This should be evaluated on the basis of previous survey rounds.
- Only the short form of the WSM should be considered for inclusion in existing survey questionnaires, to avoid an excessive burden on respondents (the questionnaires of existing surveys are already long).
- The WSM should be incorporated only in the household survey implemented by most of the developing countries; the choice of the recall period, the sampling strategy and other methodological aspects would then be consequential.
- The linkages between the goals of the WSM and the monitoring of SDG goals and targets should be better investigated.

The WSM was then revised, and **two versions** proposed: a Basic one, tested in Lesotho in September 2017, and a Modified one, tested in Ecuador between August and November 2017. While, in the basic version, the quantities of fuelwood and charcoal used by a household were investigated for every single use, in the modified version, only the total quantity used was sought. Respondents were then asked for the purposes for which each declared quantity was used. The other major difference between the two versions regarded the reference period: while in the basic version it was a “fixed” period of time, in the modified version, respondents were asked about the frequency of use, purchase, collection, etc.; the quantities reported were then referred to the declared frequency.

Although the short version of the WSM is more likely to be introduced in survey questionnaires, the long versions of both the basic and the modified WSM were tested; this provided the opportunity to test all of the proposed questions, independently of their inclusion in the final version of the WSM.

A **Manual for Enumerators** was also developed in both English and Spanish, explaining the rationale behind each question of the two versions of the WSM.

The two **field tests** provided several useful suggestions on how to further improve the design of the WSM, as discussed below.

## Lesotho, Basic WSM (Global Strategy, 2018a)

- To obtain a precise figure of the number of people consuming fuelwood and charcoal in the last week, it is important to take into account some of Lesotho's specificities: some "usual" household members may be absent due to migration, or other "non-usual" household members may have eaten or slept at home. Knowing the exact number of people eating and sleeping at home during the recall period is important to estimate per capita consumption correctly. The design of the roster section should be modified accordingly.
- Picnics and barbecues should be considered separate uses of fuelwood rather than being included in the "Cooking" category. Among the "cultural and religious uses" of fuelwood, moreover, "Initiation" – a traditional ceremony that involves consumption of fuelwood – should be added.
- The same bundle of fuelwood can be used for multiple purposes. For instance, it can be used first to warm water and then to cook. Therefore, a code should be introduced to identify the quantities of wood that undergo multiple uses. Such a code would help data analysts to avoid double-counting that quantity, without losing the information about the multiple use of that bundle.
- A description of the methodology on how to measure the volume of logs should be included in the interviewer's manual.
- Fuelwood may be collected by the members of a household for the members of another household and given to them for free. Therefore, relevant questions should be added in section 2.C on fuelwood sales.
- The questions on the "type of wood used" and the "type of energy source" for a given stove or heater should be multiple-choice questions. The lists of stoves and heaters should also be adapted to reflect the types available in the country.
- The phrasing of the question on health problems incurred by household members should be changed to clarify that the health problems are due to "fuel burning".
- For wood received as in-kind payment or barter, it is difficult to estimate a usual daily amount. The reference period should therefore be changed from "daily" to "monthly".
- Questions on the "estimated weight" should only be asked when no wood or charcoal are available for an actual measurement; the Manual should provide more precise details on how to "estimate" the weight of woodfuel (see annex 3 of these Guidelines).
- Another useful conclusion of the field test implemented in Lesotho concerned the length of the interview. The average duration of both CAPI and PAPI processes was approximately 45 minutes, including the time required to weigh woodfuel. Considering that the WSM is a survey module to be incorporated in existing survey questionnaires – which already include several sets of questions on multiple topics – this time period is exceedingly long. The long version of the WSM could be therefore be used as a stand-alone woodfuel survey, although in that case it should be integrated with additional sections such as an introduction about the main goals of the interview and a section on the socio-economic characteristics of the household (income, etc.).
- Other suggestions provided by the enumerators will be considered in the development of the final version of the WSM.
  - It was suggested to delete the questions on the "estimated" weight, as they might generate confusion in the respondent, and to keep only the questions on either the actual weight, measured in kg, or volume (in m<sup>3</sup>).
  - It was also suggested to add boxes to the paper questionnaire in which to record the values of the diameter and length of logs, when volume is measured instead of weight.
  - Finally, in Lesotho, pupils consider it normal to collect fuelwood on their way home from school; it was thus suggested to remove "Schooling problems" or "Missing school days" from the list of possible negative consequences of fuelwood collection.

### **Ecuador, Modified WSM (Global Strategy, 2018c)**

- It is preferable to investigate the actual weight of wood directly, without asking respondents to estimate it, as this double question on weight might generate confusion in the respondents. Estimated weight should only be asked when there is not enough wood to weigh at home or in its proximity.
- The design of the module should be modified to allow for recording the values of the diameter and length of a log – and thus for estimating its volume – and the tree species, which is necessary to infer the density coefficient of wood. A numeric code should also be introduced to indicate the unit of measurement (kg or m<sup>3</sup>). A list of density coefficients by tree species should also be added to the Manual for Enumerators.
- A possible alternative to asking the quantity of a representative day of the last week could be to ask the quantity consumed in the entire week, or to ask the frequency of consumption of fuelwood and refer the quantity to the mentioned reference period. Also, for CAPI surveys, it may be possible to program error messages that “pop up” whenever the quantities declared by respondents exceed a certain threshold.
- The frequency of fuelwood collection should only be asked once per household, rather than once per type of fuelwood. Thus, it is possible to estimate the total amount of time spent by the household on this activity.
- Rather than asking the amount of charcoal consumed in the last week, the question on frequency should also be asked with regard to charcoal consumption. This will allow to better record quantities by households who only consume charcoal occasionally.
- The quantity of wood used to produce charcoal should be investigated better, to estimate the wood-to-charcoal rate. Also, “own land” should be listed among the sources of wood used to produce charcoal.
- The question on sales of charcoal should be referred to the same period as charcoal production, to understand how much of the produced quantity was actually sold.

Prior to the Ecuadorean field test, the WSM underwent a cognitive test (Global Strategy, 2018b) and two pre-tests. The main conclusions of the two pre-tests are summarized below:

- The production and use of fuelwood and charcoal are localized in remote rural areas of the country.
- The “last week” is a more appropriate reference period for consumption of fuelwood, compared to the last month or the last hot or cold season. On the contrary, the reference period to be adopted for the acquisition and sales of fuelwood should be either the last month or a period chosen by the respondent (based on the “frequency” of acquisition or sale).
- The proposed categories for cooking stoves and heaters should be modified to match those used most often in the country.
- The questions should be rephrased in simpler terms, because in remote areas of the country, not all respondents have a high level of education; in some areas, translators will be required to translate the questions from Spanish to Quechuan or other local or indigenous languages.
- For the consumption, acquisition and sales of charcoal, the reference period should be longer than the one proposed.



# Annex 2

## The Woodfuel Supplementary Module (WSM)



## WOODFUEL MODULE

COUNTRY  
NSO LOGO



CONFIDENTIALITY:

THE DATA PROVIDED BY THE RESPONDENT ARE STRICTLY CONFIDENTIAL,  
AND WILL ONLY BE USED FOR STATISTICAL PURPOSES

### A. GEOGRAPHICAL LOCATION

REGION 1	<input type="text"/>	1	Province	<input type="text"/>
1. REGION	REGION 2	<input type="text"/>	2	District
REGION 3	<input type="text"/>	3	5. Administrative level 5	<input type="text"/>
			6. Administrative level 6	<input type="text"/>
URBAN	<input type="text"/>	1	7. Administrative level 7	<input type="text"/>
2. AREA			8. Dwelling number	<input type="text"/>
RURAL	<input type="text"/>	2	9. Household number	<input type="text"/>

### C. HOUSEHOLD INFORMATION

Household number	<input type="text"/>
Name of respondent	<input type="text"/>
Phone number	<input type="text"/>
Date of interview	YEAR <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> MONTH <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> DAY <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

### D. RESPONSIBLE STAFF

SUPERVISOR:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	cod.	<input type="text"/>	<input type="text"/>
ENUMERATOR:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	cod.	<input type="text"/>	<input type="text"/>
				QUALITY CONTROL			

### B. IDENTIFICATION AND LOCATION OF THE DWELLING

Block:	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	Building:	<input type="text"/>	<input type="text"/>
Locality:	<input type="text"/>						
Address:	<input type="text"/>						
Floor No.	<input type="text"/>	House No.	<input type="text"/>	Depart. No.	<input type="text"/>	<input type="text"/>	<input type="text"/>

## SECTION 1: HOUSEHOLD ROSTER – FOR ALL HOUSEHOLD MEMBERS

HOUSEHOLD MEMBERS				SEX	AGE	RELATIONSHIP	EATING AT HOME LAST 7 DAYS	SLEEPING AT HOME LAST 7 DAYS	ETHNIC SELF- IDENTIFICATION		
Record first and last name(s) of all the usual members of the household				Male .....1 Female .....2	How old is (...), in years?  <div style="border: 1px solid black; padding: 2px; display: inline-block;">             If (...) is              less than              1 year              old, write              00           </div>	Relationship with the household head  Head.....1 Spouse.....2 Son, daughter.....3 Son-in-law, daughter-in-law...4 Grandson, Granddaughter....5 Parents, Parents-in-law.....6 Other relatives.....7 Maid, domestic, herd boy.....8 Other, no relatives.....9	Did (...) eat at home in the last 7 days?  Yes .....1 No .....2	Did (...) sleep at home in the last 7 days?  Yes .....1 No .....2	How do you identify yourself based on your culture and customs?  Group 1? .....1 Group 2? .....2 Group 3? .....3 Group 4? .....4 Group 5? .....5 Group 6? .....6 Other (.....) ..7		
1st NAME	2nd NAME	LAST NAME	2nd LAST NAME							1	2
CODE											
1							1				
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

## SECTION 2: FUELWOOD

### 2.A USE OF FUELWOOD

1. In the last 7 days, did you or any member of your household use fuelwood for any domestic, agricultural, commercial, cultural or religious purpose?

YES ..... 1 NO ..... 2

Skip to Question 7

2. In how many days?

3. What was the usual amount of fuelwood consumed by the household in one day?

A. WEIGHT				B. VOLUME			
Type	Quantity (No)	Unit Weight (kg)	Total Weight (kg)	Type	d1 (m)	d2 (m)	L (m)
1 bundle				1 Log			
2 sack				2 Truck			
3 Log				3 Load			
4				4			

4. [ENUMERATOR: Record the value of wood moisture as shown on the display of the hygrometer].

%

#### OBSERVATIONS

#### ENUMERATOR

##### How to weigh wood?

Form a bundle (or fill a sack) with the actual quantity of fuelwood used for the first declared use and weigh it with the provided scale. If quantity is such that more than one bundle should be formed, weigh only one bundle and ask the total number of bundles (or sacks) used. Total quantity must be expressed in kg. Following quantities [also in the following sections of the module] should be expressed in terms of number of bundles/sacks like the one weighed, allowing for fractions. Hence, fuelwood should only be weighed once.

##### How to estimate volume?

Record the values of diameters at mid-log ( $d_1$  and  $d_2$ ) and the length ( $L$ ) of the log in the appropriate boxes. The three measures must be expressed in meters. Then calculate the volume using the Huber formula:  $V = \{(d_1 + d_2)/2\}^2 * 3.1416/4 * L$ . The final weight is obtained by multiplying the volume by the density coefficient of wood, which depends on the tree species.

##### How to estimate weight?

Weight should only be estimated when there is no wood to weigh at home at the time of the interview, but wood was actually used during the reference period. The respondent should estimate the daily amount of wood using a unit of measurement of its choice (for instance: load, truck, etc.) although the final estimate should always be expressed either in kg or in  $m^3$ .

##### How to measure wood moisture?

Insert the metallic tips of the provided hygrometer into the wood used to form the bundle, then [select the wood species among those listed and] record the value of moisture shown on the display of the hygrometer.

5. In the last 7 days, did your household use fuelwood for:

YES ..... 1

NO ..... 2

6. Which use requires the higher amount of fuelwood?  
[Record the List Code]

ANSWER CODE

01 Cooking at home?

02 Having picnic, barbeque?

03 Space heating?

#### OBSERVATIONS

04 Other domestic uses, such as lighting, warming water for bathing, laundering, ironing, or smoking against insects?

05 Agricultural uses, such as roasting coffee, curing tobacco, preparing feed for animals, heating greenhouses, poultry-houses or swine-houses?

06 Commercial uses, such as baking bread, smoking fish, brewing alcoholic beverages, vending street food, running artisanal workshops or micro-industries [excluding charcoal production]?

07 Cultural or religious uses, such as cremations, incense burning, other religious rituals or cultural traditions?

## SECTION 2: FUELWOOD

### 2.A USE OF FUELWOOD

1. In the last 7 days, did you or any member of your household use fuelwood for any domestic, agricultural, commercial, cultural or religious purpose?

YES ..... 1 NO ..... 2

Skip to Question 7

2. In how many days?

3. What was the usual amount of fuelwood consumed by the household in one day?

A. WEIGHT				B. VOLUME			
Type	Quantity (No)	Unit Weight (kg)	Total Weight (kg)	Type	d1 (m)	d2 (m)	L (m)
1 bundle				1 Log			
2 sack				2 Truck			
3 Log				3 Load			
4				4			

4. [ENUMERATOR: Record the value of wood moisture as shown on the display of the hygrometer].

 %

#### OBSERVATIONS

5. In the last 7 days, did your household use fuelwood for:

YES ..... 1

NO ..... 2

6. Which use requires the higher amount of fuelwood?  
[Record the List Code]

ANSWER CODE

01 Cooking at home?

02 Having picnic, barbeque?

03 Space heating?

#### OBSERVATIONS

04 Other domestic uses, such as lighting, warming water for bathing, laundering, ironing, or smoking against insects?

05 Agricultural uses, such as roasting coffee, curing tobacco, preparing feed for animals, heating greenhouses, poultry-houses or swine-houses?

06 Commercial uses, such as baking bread, smoking fish, brewing alcoholic beverages, vending street food, running artisanal workshops or micro-industries [excluding charcoal production]?

07 Cultural or religious uses, such as cremations, incense burning, other religious rituals or cultural traditions?

#### ENUMERATOR

##### How to weigh wood?

Form a bundle (or fill a sack) with the actual quantity of fuelwood used for the first declared use and weigh it with the provided scale. If quantity is such that more than one bundle should be formed, weigh only one bundle and ask the total number of bundles (or sacks) used. Total quantity must be expressed in kg. Following quantities [also in the following sections of the module] should be expressed in terms of number of bundles/sacks like the one weighed, allowing for fractions. Hence, fuelwood should only be weighed once.

##### How to estimate volume?

Record the values of diameters at mid-log ( $d_1$  and  $d_2$ ) and the length (L) of the log in the appropriate boxes. The three measures must be expressed in meters. Then calculate the volume using the Huber formula:  $V = \{(d_1 + d_2)/2\}^2 \times \pi \times L$ . The final weight is obtained by multiplying the volume by the density coefficient of wood, which depends on the tree species.

##### How to estimate weight?

Weight should only be estimated when there is no wood to weigh at home at the time of the interview, but wood was actually used during the reference period. The respondent should estimate the daily amount of wood using a unit of measurement of its choice (for instance: load, truck, etc.) although the final estimate should always be expressed either in kg or in  $m^3$ .

##### How to measure wood moisture?

Insert the metallic tips of the provided hygrometer into the wood used to form the bundle, then [select the wood species among those listed and] record the value of moisture shown on the display of the hygrometer.

## 2.B ACQUISITION OF FUELWOOD

7. In the last 12 months, did you or any member of your household:		YES ..... <input type="checkbox"/> 1 <input type="checkbox"/> NO ..... <input type="checkbox"/> 2		8. How Frequently?		9. What was the [Frequency] Amount acquired by the household? (Please form a bundle).		10. What was the [Frequency] Expenditure on fuelwood of the household?								
LIST CODE	ANSWER CODE	Daily..... 1 Quarterly..... 5		Type		A. WEIGHT		B. VOLUME								
		Weekly..... 2 Half-yearly..... 6	1 Bundle	Quantity (No)	Unit Weight (kg)	Total Weight (kg)	Type of weight	Type of Volume	Tree species	Volume (m <sup>3</sup> )	L (m)	d1 (m)	d2 (m)	Type of Volume (1) 1 Stacked v. 2 Solid v.	Type of Volume (2) 1 Measured v. 2 Estimated v.	
01		Monthly..... 3 Yearly..... 7	2 Stack													
02		Other..... 8	3 Log													
03			4													
04																
05																

## 2.C COLLECTION OF FUELWOOD

11. Where did you MAINLY cut or collect fuelwood?		12. How long does it take to:		13. Which household members participated in fuelwood collection?		14. Please list the month(s) of the year, if any, when fuelwood is mostly unavailable.	
1. Natural Forests		1. Go from your house to the main collecting area and back?		YES ..... NO ..... 1 2		ALWAYS AVAILABLE ... 99	
2. Forest Plantations		Hours Minutes		[Member 1] [Member 7]		January	
3. Bush, river banks [and other wild systems]		Hours Minutes		[Member 2] [Member 8]		February	
4. Own farm or yard		Hours Minutes		[Member 3] [Member 9]		March	
5. Other agricultural land		Hours Minutes		[Member 4] [Member 10]		April	
6. Urban area, Village area, Roadside		Hours Minutes		[Member 5] [Member 11]		May	
7. Construction sites, dumps		Hours Minutes		[Member 6] [Member 12]		June	
8. Other (Specify) _____						July	

## 2.D FUELWOOD SOLD AND GIVEN FOR FREE

15. In the last 12 months, did you or any member of your household:		YES ..... <input type="checkbox"/> 1 <input type="checkbox"/> NO ..... <input type="checkbox"/> 2		16. How Frequently?		17. What was the [Frequency] Amount sold [given for free] by the household?		18. What was the [Frequency] Revenue obtained from fuelwood sales?								
LIST CODE	ANSWER CODE	Daily..... 1 Quarterly..... 5		Type		A. WEIGHT		B. VOLUME								
		Weekly..... 2 Half-yearly..... 6	1 Bundle	Quantity (No)	Unit Weight (kg)	Total Weight (kg)	Type of weight	Type of Volume	Tree species	Volume (m <sup>3</sup> )	L (m)	d1 (m)	d2 (m)	Type of Volume (1) 1 Measured v. 2 Estimated v.	Type of Volume (2) 1 Measured v. 2 Estimated v.	
01		Monthly..... 3 Yearly..... 7	2 Stack													
02		Other..... 8	3 Log													

## SECTION 3: CHARCOAL

### 3.A USE OF CHARCOAL

1. In the last 30 days, did you or any member of your household use charcoal for any domestic, agricultural, commercial, cultural or religious purpose?

YES ..... 1 NO ..... 2 [Go to Question 6](#)

2. In how many days?

3. What was the usual amount of charcoal consumed by the household in one day?

A. WEIGHT			
Type	Quantity (No)	Unit Weight (kg)	Total Weight (kg)
1 Sack			
2 Estimated			

4. In the last 30 days, did your household use charcoal for:

LIST CODE	YES ..... 1	NO ..... 2	ANSWER CODE
01			
02			
03			
04			
05			
06			
07			

5. Which use requires the higher amount of Charcoal?

[Record the List Code]

### 3.B ACQUISITION OF CHARCOAL

6. In the last 12 months, did you or any member of your household:

YES ..... 1 NO ..... 2

LIST CODE	A. WEIGHT				B. VOLUME			
	Type	Quantity (No)	Unit Weight (kg)	Total Weight (kg)	Type	Quantity (No)	Unit Volume (m³)	Total Volume (m³)
01	Purchase charcoal?				1 Measured			
02	Receive charcoal as payment in-kind?				2 Estimated			
03	Receive charcoal in exchange for other goods (barter)?							
04	Receive charcoal as a gift?							
05	Produce charcoal?							

7. How Frequently?

Daily ..... 1 Quarterly ..... 5  
Weekly ..... 2 Half-yearly ..... 6  
Fortnightly ..... 3 Yearly ..... 7  
Monthly ..... 4 Other ..... 8

8. What was the [Frequency] Amount acquired [produced] by the household?

9. What was the [Frequency] Expenditure on charcoal of the household?

3.C PRODUCTION OF CHARCOAL											
10. What was the [Frequency, Q.9] Amount of wood used to produce charcoal?											
11. How did you MAINLY obtain the wood used to produce charcoal?											
12. What type of kiln was used to produce charcoal?											
1. Earth pit..... 2. Earth mound..... 3. [Other traditional kiln]..... 4. Casamance..... 5. Brick kiln..... 6. Steel kiln..... 7. Portable steel kiln..... 8. [Other improved kiln].....											
13. How many days does charcoal production require?											
14. Which household members participated in charcoal production? [Use the same codes as those provided in Section 1. Roster]											
15. In the last 12 months, did you or any member of your household:											
16. How Frequently?											
17. What was the [Frequency] Amount sold [given for free] by the household?											
18. What was the [Frequency] Revenue obtained from charcoal sales?											

3.D CHARCOAL SOLD AND GIVEN FOR FREE											
15. In the last 12 months, did you or any member of your household:											
16. How Frequently?											
17. What was the [Frequency] Amount sold [given for free] by the household?											
18. What was the [Frequency] Revenue obtained from charcoal sales?											

OBSERVATIONS											

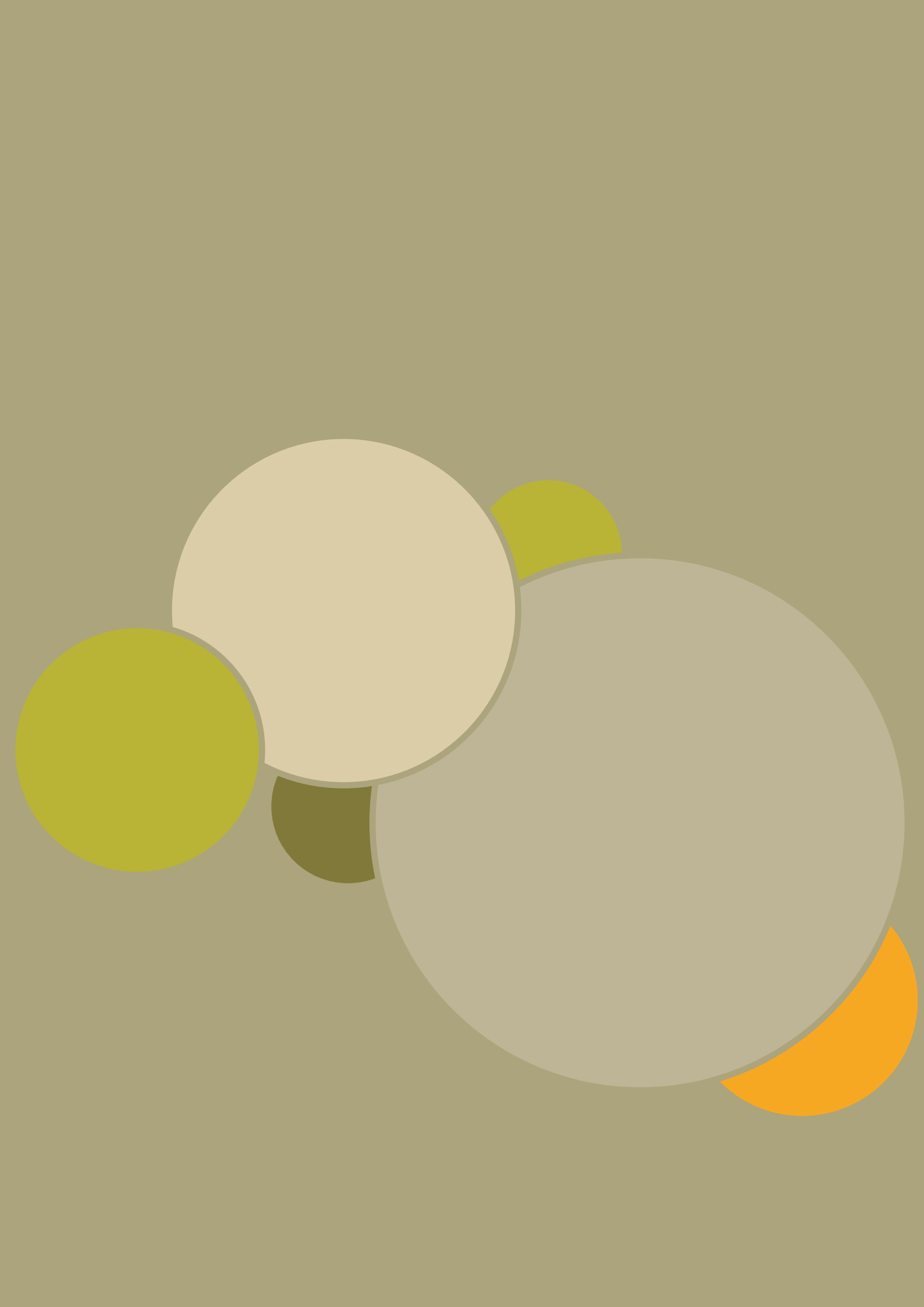
## SECTION 4 COOKING AND HEATING

1. Which of the following types of stove does your household use for cooking? [Select all that apply]		2. What is its MAIN fuel or source of energy?	3. Where is the stove located?	4. Are there windows, extractor hoods, fans or chimneys in the cooking area?	5. Which of the selected stoves is used for most of the time?
STOVE CODE	<div> <div>YES ..... 1</div> <div>NO ..... 2</div> </div> <div> <div>NO STOVE / NOT COOKING AT HOME..... 99</div> <div>Go to Question 6</div> </div>	<div> <div>Electricity – public grid.....1</div> <div>Electricity – local grid.....2</div> <div>Electricity – generator.....3</div> <div>Solar panel.....4</div> <div>Piped gas.....5</div> <div>LPG.....6</div> <div>Biogas.....7</div> <div>Alcohol/ethanol.....8</div> <div>Gasoline/diesel.....9</div> <div>Kerosene/paraffine.....10</div> </div> <div> <div>Coal/Lignite.....11</div> <div>Charcoal.....12</div> <div>Firewood.....13</div> <div>Wood pellets, briquettes.....14</div> <div>Wood chips, residues.....15</div> <div>Crop waste, grass, straw.....16</div> <div>Animal waste, dung.....17</div> <div>Garbage/plastic.....18</div> <div>Other.....19</div> </div>	<div> <div>Indoor, in a dedicated kitchen ..... 1</div> <div>Indoor, in the living / sleeping area.....2</div> <div>In a separate building.....3</div> <div>Outdoor.....4</div> </div>	<div>YES ..... 1</div> <div>NO ..... 2</div>	[Record the stove code]
01	[Improved stove 1]				
02	[Improved stove 2]				
03	[Improved stove 3]				
04	[Traditional Stove 1]				
05	[Traditional Stove 2]				
06	[Traditional Stove 3]				
HEATER CODE	<div> <div>YES ..... 1</div> <div>NO ..... 2</div> </div> <div> <div>NO HEATER / NOT HEATING HOME..... 99</div> <div>Go to Section 5</div> </div>	<div> <div>Electricity – public grid.....1</div> <div>Electricity – local grid.....2</div> <div>Electricity – generator.....3</div> <div>Solar panel.....4</div> <div>Piped gas.....5</div> <div>LPG.....6</div> <div>Biogas.....7</div> <div>Alcohol/ethanol.....8</div> <div>Gasoline/diesel.....9</div> <div>Kerosene/paraffine.....10</div> </div> <div> <div>Coal/Lignite.....11</div> <div>Charcoal.....12</div> <div>Firewood.....13</div> <div>Wood pellets, briquettes.....14</div> <div>Wood chips, residues.....15</div> <div>Crop waste, grass, straw.....16</div> <div>Animal waste, dung.....17</div> <div>Garbage/plastic.....18</div> <div>Other.....19</div> </div>	<div> <div>Indoor, in a dedicated room ..... 1</div> <div>Indoor, in the living / sleeping area.....2</div> <div>In a separate building.....3</div> <div>Outdoor.....4</div> </div>	<div>YES ..... 1</div> <div>NO ..... 2</div>	[Record the Heater code]
01	[Improved heater 1]				
02	[Improved heater 2]				
03	[Improved heater 3]				
04	[Cookstove]				
05	[Traditional Heater 1]				
06	[Traditional Heater 2]				

## SECTION 5 HEALTH PROBLEMS

11. In the last 30 days, did you or any member of your household suffer from respiratory problems, eye irritations, allergies, burns or other health problems because of fuel combustion at home?	12. Which household members suffered from such problems? [Use the same codes as those provided in Section 1. Roster]
<div> <div>YES ..... 1</div> <div>NO ..... 2</div> </div> <div> <div>Go to Question 12</div> <div>End of Module</div> </div>	<div> <div>[Member 1]</div> <div>[Member 2]</div> <div>[Member 3]</div> </div> <div> <div>[Member 4]</div> <div>[Member 5]</div> <div>[Member 6]</div> </div> <div> <div>[Member 7]</div> <div>[Member 8]</div> <div>[Member 9]</div> </div> <div> <div>[Member 10]</div> <div>[Member 11]</div> <div>[Member 12]</div> </div>





# Annex 3

## Manual for Enumerators

**WOODFUEL SUPPLEMENTARY MODULE - PAPI VERSION**

## **1. PURPOSES OF THE WSM AND OF THE MANUAL FOR ENUMERATORS**

Fuelwood and charcoal – collectively named as “woodfuel” – play an important role as source of energy in many countries in the world. More than two billion people rely on woodfuel as the main source of fuel for cooking (FAO, 2014), especially in rural areas. Ensuring access to affordable, reliable, sustainable and modern energy is one of the main goal of the 2030 Agenda for Sustainable Development. Woodfuel is also an important source of income and employment for rural households. Additionally, there are important social implications associated with woodfuel production and consumption. Women and children generally spend hours each day on collecting fuelwood for domestic use, which could be devoted to other activities that contribute to their socio-economic well-being. Furthermore, women are most likely to suffer from smoke and emissions arising from the inefficient fuel combustion mechanisms of unimproved stoves, which may even be located in unventilated kitchens.

The Woodfuel Supplementary Module (WSM) is designed to collect information on the consumption, acquisition and sales of woodfuel – and the related socio-economic implications – by the household sector. The final goal is to gather internationally comparable data through a set of standard questions to be included in the questionnaires of existing household surveys. This Manual provides guidance on the questions of the WSM, how they should be asked, and the type of information they are meant to collect.

## **2. WSM DESIGN**

The WSM comprises five sections: 1. Household Roster; 2. Fuelwood; 3. Charcoal; 4. Cooking and Heating; and 5. Health Problems. Sections 2 and 3 are divided into four subsections: A. Use; B. Acquisition; C. Production; and D. Sales. The Use subsection begins with a filter question having a “Yes/No” answer. A negative answer will trigger a skip pattern to the next section.

## **3. CONDUCTING THE INTERVIEW**

An important aspect to be considered when seeking to collect reliable data is the selection of the appropriate respondent. The person to interview should be the most knowledgeable person of the household with regard to the consumption and acquisition or production of woodfuel. This person may be the main cook, the responsible person for woodfuel purchases, or the adult responsible for collecting fuelwood or producing charcoal. If two people are identified (for example, one for consumption and one for acquisition and/or production), ideally, both should be interviewed; each person will be asked the questions of the relevant section of the WSM (for example, consumption questions will be asked to the main cook, and production questions to the collector or producer of woodfuel).

The questions must be asked exactly as worded; changing words or phrases, adding or dropping words to a question must be avoided. Also, unless in presence of a skip pattern, a question must always be asked, even when the answer is obvious to the interviewer: filling the answer without asking the question must be avoided at all times.

In section 2.A and below section 3.D, space has been provided for enumerators to record “Observations”. In those sections, the enumerator should record any problem that may have occurred during the interview process, such as problems in measuring the variables of interest or problems faced by respondents in understanding questions. Always record the question number (and the relative section) that originated the problem.

## **COVER PAGE**

After reading the confidentiality statement out loud, the enumerator should fill in BOX A – GEOGRAPHICAL LOCATION – and BOX B – IDENTIFICATION OF LOCATION OF THE DWELLING – using the identification codes of the corresponding administrative levels provided by the National Statistical Office (NSO).

### **BOX C. HOUSEHOLD INFORMATION**

Household number: If more than one household resides in the same dwelling, assign a number to each household and record the number of the interviewed household.

Name of respondent: Record the name of the person who answered the questions, preferably the person who is most knowledgeable about woodfuel consumption and production. If possible, record their phone number. This piece of information, as well as the address and other items included in box B, may become useful if, after the interview has been completed, some data results to be missing or wrong.

Report the date of the interview in the light blue box. If the interview had to be suspended and continued on another day, record both dates.

### **BOX D. RESPONSIBLE STAFF**

Write the names and codes of the enumerator, the supervisor and the officer responsible for the quality control of the collected data.

## **SECTION 1. HOUSEHOLD ROSTER**

Starting with the household head, record the names, last names, sex, age (in years) and relationship to the household head of each usual member of the household. Codes for sex (1 = male, 2 = female) and relationship to the household head are provided in the questionnaire. A person is considered a usual member of the household if (s)he usually eats and sleeps in the house. However, members of the household may not have eaten or slept at home during the reference period of the main variables. Columns 5 and 6 of section 1 account for this possibility.

In column 7, record the ethnic group of the household members, as self-identified and according to the codes provided in the questionnaire.

## SECTION 2.A USE OF FUELWOOD

**Q.1:** In the last **7 days**, did you or any member of your household use fuelwood for any domestic, agricultural, commercial, cultural or religious purpose? (Y/N)

This filter question entails a Yes/No answer. If No, go to section 2B, question 7. Otherwise, ask Q. 2. If the interview was conducted on a Wednesday, the “last 7 days” start on Wednesday of the previous week and end on Tuesday.

**Q.2:** In how many **days**?

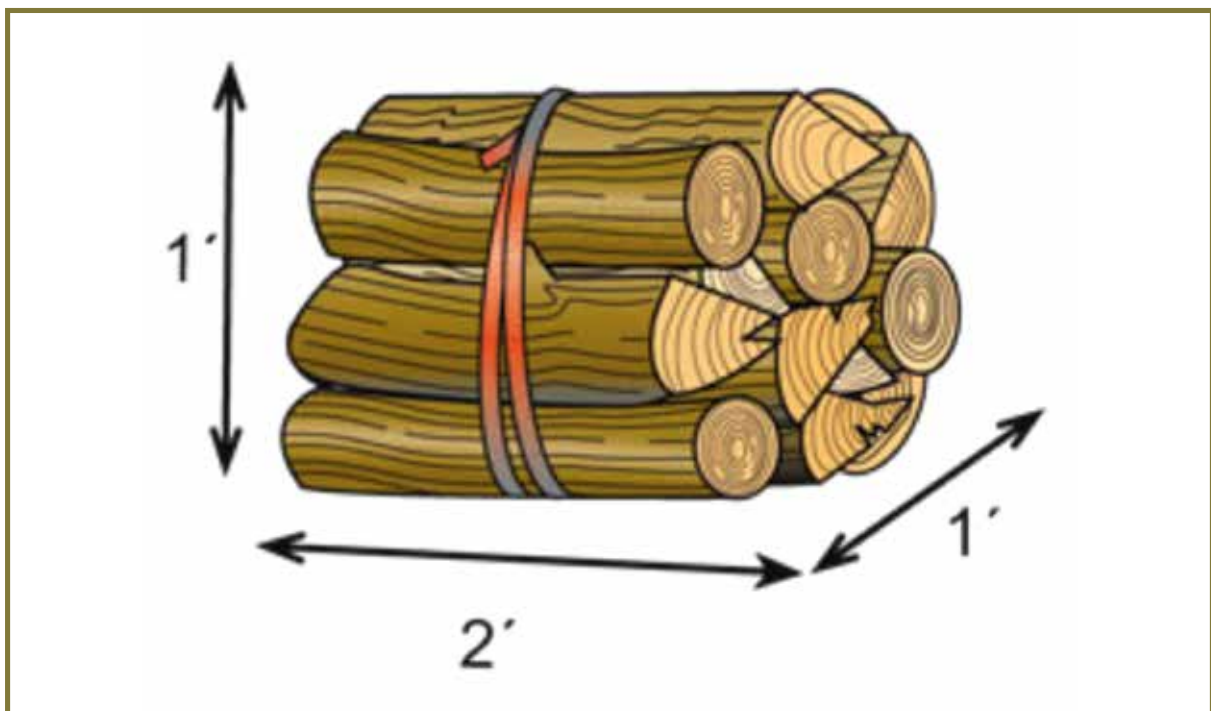
Indicate the number of days (1 to 7) on which fuelwood was used in the last 7 days. A value of 0 is not allowed, as the answer to Q.1 was “Yes”.

**Q.3:** What was the usual amount of fuelwood consumed by the household in one day?

To answer this question, the respondent will have to weigh the actual quantity of fuelwood usually consumed in 1 day. So, even if the reference period is “the last 7 days”, the quantity to be weighed is referred to **only 1**, usual, day of that 7-day period.

It is also important to note that “usual amount” should not be confused with “average” daily amount. For instance, if fuelwood was consumed for cooking only two days per week, and the quantity usually consumed in one day was 3 kg, then the quantity to be reported is 3 kg. Instead, the “average” quantity consumed in the last 7 days would be:  $3 \times 2/7 = 0.857$  kg per day.

**FIGURE 1. BUNDLE OF FUELWOOD.**



To weigh fuelwood, adopt the following procedure. The respondent is asked to form a bundle (or to fill a sack, in case of pellets, briquettes, wood chips or similar types of fuelwood) representing the typical quantity used in 1 day by the household for all possible purposes (cooking, space heating, domestic uses, commercial uses, etc.), excluding the wood used to produce charcoal (to be recorded in section 3).

The enumerator ties the material with a string and weighs it with the provided spring scale. The final quantity is reported in kg.

**FIGURE 2. A SPRING SCALE.**



If the quantity is too big to form a single bundle or sack, weigh a smaller bundle or sack and report the number of bundles or sacks composing the total quantity. The final quantity of fuelwood will be expressed in kg (for instance: 3 bundles of 1.5 kg each = 4.5 kg). To obtain precise values for the weight of a bundle, the spring balance should be calibrated at the beginning of each day of the survey using a reference weight (for example, of 1 kg). Otherwise, digital scales can be used.

In some cases, fuelwood – although commonly used by the household – may not be available at home at the time of the interview. In these cases, the weight cannot be measured and should be estimated by the respondent using local units of measurement. Conversion factors to convert those units into standard units should be sought, either through interviews with local experts<sup>1</sup> or community leaders, or with reference to existing literature<sup>2</sup>. Alternatively, if fuelwood is available in near the dwelling and the respondent is willing, the usual amount of wood can be collected at the end of the interview.

1 For instance, the transporters of wood may provide an estimate of how many kg or tons may be carried in a “truck” of wood, depending on the type of truck.  
2 See, for example: The use of non-standard units for the collection of food quantities (World Bank, 2017).

### EXAMPLE 1

Fuelwood is available at home. A bundle is formed, but the daily quantities are such that a single bundle is not enough to represent usual daily consumption (4 bundles like the one weighed are used). The weight of the formed bundle is 2.4 kg. Table A. WEIGHT, below question 3, should be filled in as follows:

A. WEIGHT				
Type	Quantity (no.)	Unit weight (kg)	Total weight (kg)	Type of weight
1. Bundle				1. Measured
2. Sack				2. Estimated
3. Log				
4.				
1	4	2.4	9.6	1

### EXAMPLE 2

Fuelwood is not available at home. The respondent reports the consumption of 2 sacks of pellet (5 kg each) for space heating. In this case, table A. WEIGHT below question 3 should be filled in as follows:

A. WEIGHT				
Type	Quantity (no.)	Unit weight (kg)	Total weight (kg)	Type of weight
1. Bundle				1. Measured
2. Sack				2. Estimated
3. Log				
4.				
2	2	5	10	2

In some cases, a log may be too big to lift and weigh with the scale. Here, an estimate of the volume, expressed in m<sup>3</sup>, should be recorded instead. There are several ways to estimate the volume of a log. The method proposed here makes use of Huber's formula:

$$V = \{[(d_1+d_2)/2]^2 * 3.1416/4\} * L$$

where d<sub>1</sub> and d<sub>2</sub> are the two diameters at the mid-log, expressed in meters; 3.1416 is the approximate value of  $\pi$ ; and L is the length of the log (m). For example, if d<sub>1</sub> = 21 cm = 0.21 m, d<sub>2</sub> = 25 cm = 0.25 m and L = 3 m, the volume would be equal to: 0.23<sup>2</sup> \* 0.7854 \* 3  $\approx$  0.125 m<sup>3</sup>.

**FIGURE 3. A CALIPER.**



The diameter can be measured using a caliper (figure 3). Diameters must be expressed in m to obtain values expressed in m<sup>3</sup>; if the diameters are reported in cm, the final value for the volume should be divided by 10 000.

The average diameter  $[(d_1+d_2)/2]$  is used because the section of a log is not a perfect circle. Therefore, using only one value for the diameter may lead to the over- or underestimation of the log's volume.

An alternative way to obtain the average diameter is to measure the circumference at the mid-log and then divide that value by  $\pi$ . Specific “diameter tapes” are available that directly provide the measure of the diameter when the circumference is measured.

If, on the other hand, the volume of a standing tree is to be measured, the height of the tree (rather than the length of the log) should be measured with a height gauge.

Once the values of  $d_1$ ,  $d_2$  and  $L$  are known, the enumerator should calculate the volume using Huber's formula (in PAPI processes), or read the value for the Volume on the tablet's display (in CAPI processes)<sup>3</sup>.

Once the volume is known, the tree species should be identified to calculate the weight of the log. Indeed, each tree species is characterized by a different density coefficient; thus, the same volume may correspond to different weights of wood depending on the tree species<sup>4</sup>.

3 Another way to estimate the volume of a log is with the Smalian formula, which requires the measurement of four (rather than two) diameters, that is, two diameters at each end of the log, in addition to the length of the log.

4 If the respondent does not know the tree species, the species mostly used for fuel in that region or area should be imputed to estimate the weight of wood.



The density coefficient corresponding to the specific tree is multiplied by the estimated volume to obtain the final value of the weight in kg. This step of the procedure, however, does not need to be performed in the field, and can be done in the statistical office at a later stage.

In the previous example ( $V = 0.125 \text{ m}^3$ ), if the tree species is “Wattle”, an average density coefficient of 0.75 could be used<sup>5</sup>, leading to a weight of  $0.125 \times 0.75 \approx 0.09375 \text{ t} = 93.75 \text{ kg}$ .

### EXAMPLE 3:

In the example described above, Table B. VOLUME, below question 3, should be filled in as follows:

VOLUME						
Type	d1 (m)	d2 (m)	L (m)	Volume (m3)	Tree species	Type of volume
1. Log						1. Measured
2. Truck						2. Estimated
3. Load						
4.						
	0.21	0.25	3	0.125	Wattle	1

**Q. 4:** Enumerator: record the value of wood moisture as shown on the hygrometer display.

**FIGURE 4. HYGROMETER (1).**



<sup>5</sup> Based on information available at <http://www.worldagroforestry.org/treesandmarkets/wood/>

**FIGURE 5. HYGROMETER (2).**



**FIGURE 6. HYGROMETER (3).**



**FIGURE 7. HYGROMETER (4).**



The energy content of wood (“Calorific value”) is affected to a great extent by its water content, which can be measured by means of electronic hygrometers (See figures 4 to 7). These instruments measure the intensity of an electric field in the wood. This intensity, however, also depends on the density of wood and therefore on the tree species, which should be known to obtain a precise estimate of wood moisture.

Several brands of hygrometers are available on the market. Their functioning is simple: two metallic tips are inserted into the wood; the wood species is selected from a list, and the value of humidity appears on the display.

**Q.5:** In the last 7 days, did your household use fuelwood for: Cooking at home? (Y/N); Having picnics, barbecues? (Y/N); Space heating? (Y/N); Other domestic uses (...)? (Y/N); Agricultural uses (...)? (Y/N); Commercial uses (...)[Excluding charcoal production]? (Y/N); Cultural or religious uses (...)? (Y/N).

Ask one use at a time, reading aloud the different types of uses that fall into each category, and record the appropriate code (1 for Yes, 2 for No). It is important to clarify that wood used for charcoal production should not be accounted for in the “Commercial Uses” category. That quantity should be reported in section 3.C. Also, the quantities used for agricultural and commercial purposes should only be accounted for if those activities are not performed in the context of a business company with legal status (incorporated) but, rather, fall within the informal sector. As for cultural and religious uses, these include funerals, weddings, community celebrations and other uses listed in the WSM.

**Q.6:** Which use requires the higher amount of fuelwood? [record the list code]

If the respondent reported only one use, write the corresponding list code in the box below Question 6 (for example, “3” for “Space heating”). If more than one use was reported, the respondent should explain which of the mentioned uses is the main one, that is, which use involves the higher consumption of fuelwood.

## **SECTION 2.B ACQUISITION OF FUELWOOD**

**Q.7:** In the last 12 months, did you or any member of your household: Purchase fuelwood? (Y/N); Receive fuelwood as payment in-kind? (Y/N); Receive fuelwood in exchange for other goods (Barter)? (Y/N); Receive fuelwood as a gift? (Y/N); Cut or collect fuelwood? (Y/N).

Ask one question at a time and record the appropriate code (1 for Yes, 2 for No). If the interview is conducted, for example, on 15 April 2018, the “last 12 months” start on 15 April 2017 and end on 14 April 2018. If the answer to a given form of acquisition – for example, purchases – is “Yes”, ask questions 8 – 10 (about frequency, quantities and monetary expenditure) and fill the boxes corresponding to that line.

If the answer is “No”, ask the following type of acquisition. Repeat the exercise for all the five categories. If the answer to item 5 (cut or collect fuelwood) is negative, Section 2.C should be skipped. Question 10 (on monetary expenditure), moreover, should only be asked for purchases (first item of the list).

**Q.8:** How frequently?

The respondent should select the frequency of acquisition of fuelwood among the proposed answer categories (daily, weekly, etc.). Report the corresponding code (for example, 1 for daily, 2 for weekly, etc.) as explained in the questionnaire.

**Q.9:** What was the [Frequency] amount acquired by the household? (Please form a bundle)

In asking this question, the frequency indicated by the respondent for question 8 should be used in place of the word [Frequency] of question 9.

**EXAMPLE:**

if the respondent stated that the household purchased fuelwood with a weekly frequency, the phrasing of question 9 would be the following: “What was the weekly amount acquired by the household?”

Quantities of fuelwood to be recorded in this and the following sections (such as Section 2.D – Fuelwood sold and given for free) will be reported in terms of number of bundles like that weighed for Section 2.A, allowing for decimals (for example, 2.5). Thus, fuelwood must be weighed only once, for any given household. If, on the other hand, fuelwood was not used by the household over the last seven days (and, therefore, no value was recorded in Section 2.A) but was acquired in some way in the last twelve months, the same procedure described for Section 2.A should be used to measure (or estimate) the amount of wood acquired by the household.

**FIGURE 8. MEASURING TAPE.**



In case of bulk acquisitions (for example, one single purchase of wood that covers the consumption of the entire year) it may not be possible to measure the total weight. If the stock of wood is available at the home at the time of the interview, the quantities can be expressed in terms of stacked volume (in m<sup>3</sup>) and then converted into *solid volume*<sup>6</sup> using a conversion factor of 1.4 for 1-m firewood, or a factor of 2 for chopped fuelwood. Quantities expressed in solid volume will then be converted into kg following the procedure described in question 3. The stacked volume can be measured with a measuring tape such as that depicted in figure 8.

Otherwise, the volume of purchased wood could be converted into the number of representative bundles with known weight (see example 4).

<sup>6</sup> While the stacked volume is the total volume of stacked material, including the space between the material pieces, solid volume does not take into account the volume of voids. See FAO, 2015 (pp. 4 and 5).

**EXAMPLE 4:**

The same respondent who declared a consumption of four bundles of fuelwood (of 2.4 kg each) over the last seven days (see example 1), declared a purchase of 100 such bundles over the last six months. Accordingly, Table A. WEIGHT under question 9 should be filled in as follows:

A. WEIGHT				
Type	Quantity (no.)	Unit weight (kg)	Total weight (kg)	Type of weight
1. Bundle				1. Measured
2. Sack				2. Estimated
3. Log				
4.				
<b>1</b>	<b>100</b>	<b>2.4</b>	<b>240</b>	<b>2</b>

**EXAMPLE 5:**

The respondent declares that they acquired a truck of wood logs of Eucalyptus, with a total volume of 5 m<sup>3</sup>; therefore, Table B. VOLUME under question 9 should be filled in as follows:

VOLUME							
Type	d1 (m)	d2 (m)	L (m)	Volume (m3)	Tree species	Type of Volume (1)	Type of volume (2)
1. Log						1. Stacked Volume	1. Measured
2. Truck						2. Solid Volume	2. Estimated
3. Load							
4.							
<b>2</b>				<b>5</b>	<b>Eucalyptus</b>	<b>1</b>	<b>2</b>

**Q. 10:** What was the [Frequency] Expenditure on fuelwood of the household?

If fuelwood was purchased, indicate the total amount of money – in local currency – spent on fuelwood by the household over the period indicated by the respondent in question 8. **IMPORTANT:** in this case, it is the total expenditure that should be reported, not the expenditure incurred in one day.

EXAMPLE: if the answer to question 8 was “weekly”, question 10 would be asked as follows: “What was the **Weekly Expenditure** on fuelwood of the household?”

## SECTION 2.C COLLECTION OF FUELWOOD

This section should be filled only if the answer to question 7.05 is “Yes”. If the answer is No, go to Section 2.D – Fuelwood Sold and Given for free.

**Q.11: Where** did you **MAINLY** cut or collect fuelwood? 1. Natural forests; 2. Forest plantations; 3. Bush, river banks, other wild systems; 4. Own farm or yard; 5. Other agricultural land; 6. Urban area, village area, roadside; 7. Construction sites, dumps; Other (Specify).

To estimate the amount of wood removed from forests, it is necessary to know the origin of the wood. Indeed, not all collected wood comes from forests: some may be obtained from the agricultural sector (cut trees, pruning) and some from shrubs or trees outside forests, while used and recovered wood can be obtained from dumps or construction sites. This is a single-choice question: respondents should select only the main source of cut or collected wood. To help respondents choose the correct response category (for instance, to distinguish between a natural forest and a forest plantation), pictures on a flash card (or on a tablet, for CAPI) should be provided to respondents.

**Q. 12: How long** does it take to:

1. Go from your house to the main collecting area and back?  
Indicate the time needed to get to the main collection area and to go back home, in hours and minutes.
2. Cut or collect fuelwood?  
Indicate the time needed to cut or collect fuelwood, in hours and minutes.

**Q.13: Which household members** participated in fuelwood collection?

The respondent should list all household members involved in this activity. Use the codes of the household roster in Section 1. **IMPORTANT:** because the answer to the question 7.05 was “Yes”, there should be at least 1 record for question 13. If people who are not usual members of the household helped the household to collect fuelwood, they should not be listed in this section, as they were not included in the household roster (Section 1). On the contrary, if some household members helped other households to collect fuelwood, they should be listed. The quantity collected for other people will then be recorded in Q. 16 (Section 2.D).

**Q.14:** Please list the month(s) of the year, if any, when fuelwood is mostly unavailable [select all that apply].

This is a multiple-choice question. The respondent should indicate the months of the year when there is no fuelwood to cut or collect. If fuelwood is available throughout the year, write 99 in the corresponding box.



## SECTION 2.D FUELWOOD SOLD AND GIVEN FOR FREE

**Q.15:** In the **last 12 months**, did you or any member of your household: Sell fuelwood? (Y/N); Give fuelwood to others **for free**? (Y/N).

Ask one question at a time and record the appropriate code (1 for Yes, 2 for No). If the answer to the first item is “Yes”, ask Questions 16–18 (about frequency, quantities and revenues) and fill in the boxes corresponding to that line. If the answer is “No”, ask the following item. If both the answers are “No”, go to Section 3.

**Q.16:** How **frequently**?

The respondent should select the frequency of sales of fuelwood (or gifts to others) from the answer categories proposed (daily, weekly, etc.). Report the corresponding code indicated in the questionnaire (1 for daily, 2 for weekly, etc.).

**Q.17:** What was the **[Frequency] amount** sold [given for free] by the household?

(See Question 9).

**Q. 18:** What was the **[Frequency] Revenue** obtained from fuelwood sales?

If fuelwood was sold, indicate the total amount of money – in local currency – obtained by the household over the period indicated by the respondent at Question 16. **IMPORTANT:** in this case, it is the total revenue that should be reported, not the revenue obtained in one day.

### EXAMPLE:

if the answer to Question 16 was “weekly”, Question 18 would be asked as follows: “What was the Weekly Revenue obtained from fuelwood sales?”

## SECTION 3.A USE OF CHARCOAL

**Q.1:** In the **last 30 days**, did you or any member of your household use charcoal for any domestic, agricultural, commercial, cultural or religious purpose? (Y/N)

This filter question allows for a Yes/No answer. In case of negative answer, go to Section 3.B, Question 6. Otherwise, ask Q. 2. If the interview is conducted on 15 April, the “last 30 days” go from 15 March to 14 April.

**Q.2:** In how many **days**?

Indicate the number of days (1 to 30) on which charcoal was used in the last 30 days. A 0 value is not allowed, as the answer to Q.1 was “Yes”.

**Q.3:** What was **the usual amount of charcoal** consumed by the household in **one day**?

The methodology to weigh charcoal is analogous to that described for fuelwood (see Q.3, Section 2.A). The main difference is that, rather than forming a bundle, respondents will have to fill a sack (or a shopping bag) and weigh that with the spring scale. Should charcoal not be available at home, ask to estimate the number of sacks consumed and the weight of each sack (Estimated weight).



**Q.4:** In the **last 30 days**, did your household use charcoal for: **Cooking** at home? (Y/N); Having picnics, **barbecue**? (Y/N); Space **heating**? (Y/N); Other **domestic** uses (...)? (Y/N); **Agricultural** uses (...)? (Y/N); **Commercial** uses (...)? (Y/N); **Cultural or religious uses** (...)? (Y/N).

Ask one use at time, reading aloud the different types of uses that fall into each category, and record the appropriate code (1 for Yes, 2 for No).

**Q.5: Which use** requires the **higher amount of charcoal**? [Record the List Code]

If only one use was reported by the respondent, write the corresponding List code in the box below Question 5 (for instance, write “3” for “Space heating”). If more than one use was mentioned, the respondent should explain which of the mentioned uses is the main one, that is, which use involves the greater consumption of charcoal.

## SECTION 3.B ACQUISITION OF CHARCOAL

**Q.6:** In the **last 12 months**, did you or any member of your household: **Purchase** charcoal? (Y/N); Receive charcoal as payment **in-kind**? (Y/N); Receive charcoal in exchange for other goods (**Barter**)? (Y/N); Receive charcoal as a **gift**? (Y/N); **Produce** charcoal? (Y/N).

Ask one question at time and record the appropriate code (1 for Yes, 2 for No). If the interview is conducted, for example, on 15 April 2018, the last 12 months start on 15 April 2017 and end on 14 April 2018.

If the answer to a given form of acquisition – for example, purchases – is “Yes”, ask Questions 7 – 9 (about frequency, quantities and monetary expenditure) and fill in the corresponding boxes on that line. If the answer is “No”, ask the following item. Repeat the exercise for all five categories.

Question 9 (monetary expenditure), however, should only be asked for purchases (first item of the list).

If the answer to Item 5 (Produce charcoal?) is negative, Section 3.C should be skipped. IMPORTANT: If a household member worked for a commercial firm producing charcoal, the correct answer is “No” and Section 3.C should be skipped.

**Q.7: How frequently?**

The respondent should select the frequency of acquisition of charcoal from the proposed answer categories (daily, weekly, etc.). Report the corresponding code (for example, 1 for daily, 2 for weekly, etc.) as explained in the questionnaire.

**Q.8:** What was the [**Frequency**] **amount** acquired [produced] by the household?

See Question 3 of Section 2 and Question 3 of Section 3.

**Q. 9:** What was the **[Frequency] Expenditure** on charcoal of the household?

If charcoal was purchased, indicate the total amount of money – in local currency – spent on it by the household over the period indicated by the respondent in Question 8. **IMPORTANT:** in this case, total expenditure should be reported, not the expenditure incurred in one day.

EXAMPLE: if the answer to Question 7 was “weekly”, Question 9 would be asked as follows: “What was the Weekly Expenditure on charcoal of the household?”

### SECTION 3.C PRODUCTION OF CHARCOAL

**Q. 10:** What was the **[Frequency, Q. 9] Amount of wood** used to produce charcoal?

Based on the frequency of charcoal production declared by the respondent in question 7 (for example, monthly), the respondent should now indicate the (monthly) quantity of wood used to produce the amount of charcoal declared in Question 8. To estimate the amount of wood, follow the procedure described in Question 3 of Section 2.A.

**Q. 11:** **How** did you **MAINLY obtain** the wood used to produce charcoal? 1. Cutting trees from natural forests; 2. Cutting trees from forest plantations; 3. Cutting trees from own farm; 4. Collecting deadwood; 5. Purchasing logs; 6. Other (Specify).

This is a single-choice question: the respondent should only indicate the MAIN way they obtained the wood used to produce charcoal. As for Question 11 of Section 2.C, pictures on a flash card (or on a tablet, for CAPI interviews) should be provided to respondents to facilitate their answer.

**Q.12:** What type of kiln was used to produce charcoal? 1. Earth pit; 2. Earth mound; 3. [Other traditional kiln]; 4. Casamance; 5. Brick kiln; 6. Steel kiln; 7. Portable steel kiln; 8. [Other improved kiln].

Indicate the code of the kiln used to produce charcoal (for example, “2” for “Earth mound”). Pictures on a flash card (or on a tablet, for CAPI) should be provided to respondents to facilitate identification of the kiln. Also, it is important that the interviewer take pictures of the kiln, to allow for subsequent checks and to build an archive of the kilns used in the country. If possible, enumerators should also take notes (in the “Observations” section below Section 3.C) to provide additional information on the kiln.

**FIGURE 9.  
EARTH PIT (1).**



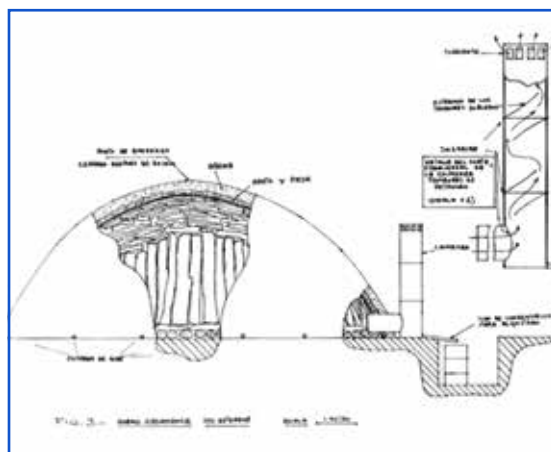
**FIGURE 10.  
EARTH PIT (2).**



**FIGURE 11.  
EARTH MOUND.**



**FIGURE 12.  
CASAMANCE (IMPROVED EARTH MOUND).**



**FIGURE 13.  
BRICK KILN.**



**FIGURE 14.  
RETORT (AN IMPROVED STEEL KILN).**



**Q.13:** How many days does charcoal production require? [this includes: Going from home to the main charcoal production area and back; Acquiring and transporting wood; Preparing the kiln; Burning wood and discharging charcoal].

Record the number of days required to complete all necessary steps of the charcoal production cycle. A 0 value is not allowed.

**Q.14:** Which household members participated in charcoal production? [Use the same codes as those provided in Section 1. Roster].

All household members involved in this activity in the last month should be listed by the respondent. Use the codes of the household roster in Section 1. **IMPORTANT:** because the answer to Question 6.05 was “Yes”, there should be at least one record for question 14.

If some people who are not usual members of the household helped the household to produce charcoal, they should not be listed in this section, as they were not included in the household roster.

### **SECTION 3.D CHARCOAL SOLD AND GIVEN FOR FREE**

**Q.15:** In the last 12 months, did you or any member of your household: Sell charcoal? (Y/N); Give charcoal to others for free? (Y/N).

Ask one question at time and record the appropriate code (1 for Yes, 2 for No). If the answer to the first item is “Yes”, ask Questions 16–18 (about frequency, quantities and revenues) and fill the boxes corresponding to that line. If the answer is “No”, ask the following item. If both the answers are “No”, go to Section 4 – Cooking and Heating.

**Q.16:** How frequently?

The respondent should select the frequency of sales (or gifts to others) of charcoal from the proposed answer categories (daily, weekly, etc.). Report the corresponding code indicated in the questionnaire (for example, 1 for daily, 2 for weekly, etc.).

**Q.17:** What was the [Frequency] amount sold [given for free] by the household?

(See Question 9, Section 2.B).

**Q. 18:** What was the [Frequency] Revenue obtained from charcoal sales?

If charcoal was sold, indicate the total amount of money – in local currency – obtained by the household over the period indicated by the respondent in Question 16. **IMPORTANT:** in this case, the total revenue should be reported, not the revenue obtained in one day.

**EXAMPLE:** if the answer to Question 16 was “monthly”, Question 18 would be asked as follows: “What was the Monthly Revenue obtained from charcoal sales?”

## SECTION 4 COOKING AND HEATING

**Q.1:** Which of the following types of stove does your household use for cooking? [select all that apply].

This is a multiple-choice question. Response categories should reflect the main types of stove used in a given country. Respondents must mention all stoves used by the household for cooking, even those that are only rarely used. For example, the second stove may be a stove used only during weekends for preparing specific foods (or for barbecuing), or may be the second-best option, used when the main stove is unavailable (for example, because of lack of electricity or gas). Pictures on a flashcard (or on a tablet, in CAPI) should be provided to respondents to identify the category of stove(s) used to cook. To distinguish between traditional and manufactured solid fuel stoves, see: <http://catalog.cleancookstoves.org/stoves>

Should there be no stove (or no cooking) in the home, write the code 99 in the corresponding box and go to Question 6.

**Q.2:** What is its MAIN fuel or source of energy? 1. Electricity – public grid; 2. Electricity – Local grid; 3. Electricity – Generator; 4. Solar panel; 5. Piped gas; 6. LPG (gas cylinders); 7. Biogas. 8. Alcohol/Ethanol; 9. Gasoline/Diesel; 10. Kerosene/paraffin; 11. Coal/Lignite; 12. Charcoal; 13. Firewood; 14. Wood pellets, briquettes; 15. Wood chips, residues; 16. Crop waste/grass/straw; 17. Animal waste, dung; 18. Garbage/plastic; 19. Other (specify).

For each stove used by the household, indicate the MAIN source of energy or fuel used to cook. IMPORTANT: for a given type of stove, if more than one type of fuel can be selected (for example, in an open fire, fuelwood, dung, wastes and plastic can all be burnt), only the main one (in terms of quantities used) should be indicated by the respondent.

**Q.3:** Where is the stove located? 1. Indoor, in a dedicated kitchen. 2. Indoor, in the living or sleeping area; 3. In a separate building; 4. Outdoor.

This is a single-choice question. Record the appropriate code into the box.

IMPORTANT: what should be recorded is the location of the stove (that is, of the source of emissions), not of the kitchen. Moreover, a given type of stove can have multiple locations (for instance, an open fire can be indoors or outdoors, depending on the climatic conditions). Select the location where the stove is positioned most of the year.

**Q.4:** Are there windows, extractor hoods, fans or chimneys in the cooking area? (Y/N)

Record 1 for “Yes” and 2 for “No”. If the location is outdoors, record “Yes” when there is a chimney or any other device that prevents smoke from re-entering the house from the door or the windows.

**Q.5:** Which of the selected stoves is used for most of the time? [record the stove code]

The respondent should indicate the main stove, that is, the stove used for most of the time to cook. The code to be reported is the corresponding stove code of Question 1 (for example, write “3” if a gas stove is used).

**Q.6:** Which of the following types of appliance does your household use to heat home when needed? [select all that apply].

This is a multiple-choice question. The response categories should reflect the main types of heating appliances used in a given country. Respondents must mention all heaters used by the household to heat the home when needed, even those that are only rarely used. For example, the second heater might be one that is used when the main heating system is unavailable (because of a lack of electricity, gas, etc.). In some cases, the same stove used to cook is also the main heater used to heat the home.

Pictures on a flash card (or on the tablet, in case of CAPI) should be provided to respondents to identify the category of heater(s) used.

Should there be no heaters at home, write the code 99 in the corresponding box and go to Section 5 (Health Problems).

**Q.7:** What is its MAIN fuel or source of energy? 1. Electricity – public grid; 2. Electricity – Local grid; 3. Electricity – Generator; 4. Solar panel; 5. Piped gas; 6. LPG (gas cylinders); 7. Biogas. 8. Alcohol/Ethanol; 9. Gasoline/Diesel; 10. Kerosene/paraffin; 11. Coal/Lignite; 12. Charcoal; 13. Firewood; 14. Wood pellets, briquettes; 15. Wood chips, residues; 16. Crop waste/grass/straw; 17. Animal waste, dung; 18. Garbage/plastic; 19. Other (specify).

For each heater used by the household, indicate the MAIN source of energy or fuel used. IMPORTANT: for a given type of stove, if more than one type of fuel can be selected (for example, in an open fire, fuelwood, dung, wastes and plastic can all be burnt), only the main one (in terms of quantities used) should be indicated by the respondent.

**Q.8:** Where is the heater located? 1. Indoors, in a dedicated room. 2. Indoors, in the living or sleeping area; 3. In a separate building; 4. Outdoors.

This is a single-choice question. Record the appropriate code into the box.

IMPORTANT: what should be recorded is the location of the source of emissions, not of the source of heat, as in some cases, they may be different (for example, a gas boiler is usually located in a separate building, although the heat comes from radiators in the sleeping area; the location to be recorded in that case is “3. In a separate building”). For sources of heat that can have multiple locations (for example, an open fire can be indoors or outdoors, depending on the climatic conditions), select the location where it is positioned most of the year.

**Q.9:** Are there windows, extractor hoods, fans or chimneys in the cooking area? (Y/N)

Record 1 for “Yes” and 2 for “No”. If the location is outdoors, record “Yes” if there is a chimney or any other device that prevents smoke from re-entering the house through the door or the windows. IMPORTANT: what matters is the location of the source of emissions, not of the source of heat, as in some cases the two sites may be different (see Question 8).

**Q.10:** Which of the selected heating systems is used most of the time? [record the heater code]

The respondent should indicate the main heating system, that is, the heater used most of the time. The code to be reported is the corresponding Heater code of Question 6 (for example, write “3” for “Paraffin heater”).

## SECTION 5 HEALTH PROBLEMS

11. In the last 30 days, did you or any member of your household suffer from respiratory problems, eye irritations, allergies, burns or other health problems because of fuel combustion at home?

This is a filter question. If the answer is “Yes”, ask Question 12. Otherwise, the WSM ends here. It is important to specify the health problems related to fuel combustion, to avoid reporting health problems or injuries that occurred at home but were not caused by smoke inhalation or similar causes.

12. Which household members suffered from such problems? [use the same codes as those provided in Section 1. Roster]

Select the household members who suffered from health problems because of fuel combustion at home. IMPORTANT: if the answer to Q. 11 was “Yes”, at least one member should be selected.



# Annex 4

## Glossary

**Agrofuel** [FR: Sous-produits agricoles; ES: Subproductos agrícolas].

Agrofuels are a subcategory of biofuels, which in turn constitute a subcategory of renewable energy sources. Agrofuels are biofuels obtained as a product of energy crops and/or agricultural by-products; they include dedicated energy crops (plants grown specifically for the production of biofuels), agricultural by-products (by-products from crop harvesting and other agricultural activities), animal by-products (from cattle, pigs, poultry, horses, etc.) and agro-industrial by-products (produced in food, feed and fibre processing industries, including: sugar cane bagasse; rice husks and hulls; coconut shells, husks, fiber, and pith; olive pressing residues; etc.) (FAO, 2004).

**Bioenergy** [FR: Bioénergie; ES: Bioenergía].

In energy statistics, the term “bioenergy” covers all energy derived from biofuels. It comprises purpose-grown energy crops, managed natural forests, multipurpose plantations and by-products (residues and wastes) from both production and processing areas. Biomass may be considered one form of transformed solar energy. From this point of view, bioenergy is a renewable energy source (FAO, 2004).

**Biofuel** [FR: Biocombustible; ES: Biocombustible].

Solid, liquid or gaseous fuel produced directly or indirectly from biomass (FAO, 2015b). Biofuels are a subcategory of renewable energy sources and comprise woodfuel, agrofuels and municipal by-products.

**Biomass** [FR: Biomasse; ES: Biomasa].

Any material of biological origin (plant- or animal-based), excluding material embedded in geological formations and transformed to fossil. It includes herbaceous biomass, fruit biomass, woody biomass, animal biomass, biomass by-products, etc.

**Briquette** [FR: Briquette; ES: Briqueta].

Densified woodfuel in the form of cubic or cylindrical units, produced by compressing pulverized woody biomass (the pulverized material may also be derived from herbaceous or fruit biomass, and biomass blends or mixtures). Briquettes are usually manufactured in a piston press. The total moisture of the biofuel briquette is usually less than 15 percent of the mass.



**Bulk volume (loose volume)** [FR: Volume apparent; ES: Volumen aparente].

Volume of small pieces of loose wood (for example, wood chips, residues) including the space between the wood pieces (that is, including air gaps). It is measured in bulk m<sup>3</sup> (bcm – bulk m<sup>3</sup>).

**Caliper** [FR: Pied à coulisse; ES: Calibre].

A device used to measure the distance between two opposite sides of an object. To measure the diameter of wood logs, Vernier calipers and digital calipers are commonly used.

**Calorific value (heating value)** [FR: Pouvoir calorifique; ES: Poder calorífico].

Energy amount per unit mass or volume released on complete combustion. The greater the moisture content of wood, the lower the amount of final energy that can be used for any thermal purpose, as part of the energy released during the combustion process is spent in water evaporation (2,44 MJ per kg of water). Therefore, two different heating values are defined: gross calorific value and net calorific value. The latter is the calorific value of oven-dry wood and varies among tree species within a very narrow interval (from 18.5 MJ to 19 MJ per kg, with slightly higher values in conifers). The most decisive factor for a high energy yield is therefore water content (FAO, 2015b).

**Computer-Assisted Personal Interviewing (CAPI)**

Personal interview conducted with the aid of tablets rather than paper questionnaires. Compared to PAPI interviewing, it allows for a substantial reduction of errors, more timely release of data (as the data are directly collected in an electronic form) and a number of other advantages, among which the possibility to connect the tablet to other electronic devices (gas sensors, electronics scales, etc.).

**Charcoal** [FR: Charbon de bois; ES: Carbón vegetal].

Solid residue derived from pyrolysis (carbonization) of fuelwood (FAO, 2004) in charcoal kilns.

**Density** [FR: Densité, masse volumique; ES: Densidad].

Ratio of mass to volume. It is always necessary to specify whether the density refers to the density of individual particles or to the “bulk density” of the material (mass of solid fuel divided by the volume of the container), and whether the mass of water in the material particles is included. It is measured in kg per m<sup>3</sup> (kg/m<sup>3</sup>). Each tree species is characterized by a different range of density values, which are also influenced by the moisture content of wood. Accordingly, “basic density” is the ratio of the mass on a dry basis and the solid volume on a green basis.

**Direct fuelwood** [FR: Bois de chauffage direct; ES: Leña directa].

Fuelwood obtained from forests and non-forest land (for example, logging, thinning and landscape management residues, deadwood, etc.).

**Dry basis** [FR: Base anhydre; ES: Base seca]

Condition in which the solid biofuel is free from moisture.

**Energy density** [FR: Densité énergétique; ES: Densidad energética]

Ratio of the net calorific value to the bulk density.

**Energy crops (fuel crops)** [FR: Cultures énergétiques; ES: Cultivos energéticos]

Woody or herbaceous crops grown specifically for their fuel value.

**Energy efficiency** [FR: Efficacité énergétique; ES: Eficiencia energética].

The ratio between the useful output and input of an energy conversion process. The energy efficiency of woodfuel combustion is influenced to the greatest extent by the amount of wood moisture and the type of conversion technology used (type/model/construction material of cooking stoves, heaters and charcoal kilns).

**Firewood** [FR: Bûches pour chauffage; ES: Leña]

Cut and split oven-ready fuelwood used in wood-burning appliances such as stoves, fireplaces or central heating systems. It usually has a uniform length, typically in the range of 15 cm to 50 cm.

**Forest degradation** [FR: Dégradation des forêts; ES: Degradación forestal].

Forest degradation is the process in which the biological wealth of a forest area is permanently diminished (for example, there being a lower number of trees, or of species of trees, plants or animals) by an external factor. Forest degradation makes the forest less valuable and may lead to deforestation (a reduction of the forest area).

**Forest plantations** [FR: Plantation forestières; ES: Plantación forestal].

Short-rotation energy plantations, generally established on agricultural land by regenerating new stems (shoots) from stumps or roots. Fast-growing species such as poplar, willow and eucalyptus are commonly used, to harvest over a one to five-year cycle.

**Fuel** [FR: Combustible; ES: Combustible]

Energy carrier intended for energy conversion.

**Fuelwood** [FR: Bois de feu; ES: Leña].

Woodfuel where the original composition of the wood is preserved. Based on its major traded forms, it can be categorized as: i) firewood; ii) log wood; iii) wood chips; iv) wood residues; v) pellets; and vi) briquettes. Based on the source of wood, fuelwood can also be divided into direct wood, indirect wood and used or recovered wood.

**Hygrometer** [FR: Hygromètre; ES: Higrómetro].

An instrument used to measure the water vapour in the atmosphere, in soil, or in confined spaces. To measure the moisture content of wood, resistive hygrometers are used. These measure the change in electrical resistance of wood resulting from its moisture content.

**Household** [FR: Ménage; ES: Hogar].

A group of persons who make common provision for food, shelter and other essentials for living (such as on childbearing, education, health care, consumption, labour force participation, migration and savings) (UN, 2017).

**Indirect fuelwood** [FR: Bois de feu indirect; ES: Leña indirecta].

Fuelwood obtained as a by-product of wood industry processes (for example, wood processing; pulp and paper industry; etc.).

**Informal sector** [FR: Secteur informel; ES: Sector informal].

“Sector consisting of units engaged in the production of goods or services that typically operate at a low level of organization, with little or no division between labour and capital as factors of production, and on a small scale. Labour relations, where they exist, are based mostly on casual employment, kinship or personal and social relations rather than contractual arrangements with formal guarantees. The production units of the informal sector have the characteristic features of household enterprises. The fixed and other assets used do not belong to the production units as such, but to their owners. The owners must raise the necessary financing at their own risk and are personally liable, to an unlimited extent, for any debt or obligations incurred in the production process. Expenditure for production is often indistinguishable from household expenditure. Similarly, capital goods such as buildings or vehicles may be used indistinguishably for business and household purposes. For statistical purposes, the informal sector is regarded as a group of production units which, according to the definitions and classifications provided in the United Nations System of National Accounts (Rev. 4) form part of the household sector as household enterprises or, equivalently, unincorporated enterprises owned by households. Within the household sector, the informal sector comprises (i) ‘informal own-account enterprises’ and ‘enterprises of informal employers’. The informal sector is defined irrespective of the kind of workplace where the productive activities are carried out, the extent of fixed capital assets used, the duration of the operation of the enterprise (perennial, seasonal or casual) and its operation as a main or secondary activity of the owner”. (UN, 2000).

**Log wood** [FR: Tronc; ES: Tronco].

Cut fuelwood in which most of the material has a length of 50 cm or more.

**Moisture content** [FR: Teneur en humidité; ES: Contenido de humedad].

Wood moisture can be expressed as “water content” and “wood humidity”.

**Water content** is the ratio of the mass of water to the weight of fresh wood; it is mostly used in the marketing of fuelwood.

The formula is:  $M = \frac{W_w - W_o}{W_w} * 100$

where:

$M$  = water content

$W_w$  = wet weight of wood

$W_o$  = oven-dry weight of wood (on a dry basis).

For example, if a given amount of fresh fuelwood weighs 100 kg, of which 25 kg of water, the water content is:

$$M = \frac{100 - 75}{100} * 100 = 25\%$$

**Wood humidity** is the ratio of the mass of water in relation to the weight of oven-dry wood, hence the ratio of water mass to dry mass; it is mostly used in the wood industry.

The formula is:  $u = \frac{W_w - W_o}{W_o} * 100$

Following the example above, in this case wood humidity would be  $M = \frac{100 - 75}{75} * 100 = 33\%$

Wood moisture can be measured through hygrometers.

**PAPI face-to-face**

Face-to-face Paper-And-Pencil-Interviewing. Type of personal interview in which the enumerator records the information provided by the respondent on a paper questionnaire. Compared to CAPI, it requires the gathered data to be manually entered into a database.

**Pellets** [FR: Granulés de bois; ES: Pellet].

Densified biofuel made from pulverized biomass, usually with a cylindrical form, random length (typically 5 mm to 40 mm) and broken ends. The total moisture of biofuel pellets is usually lower than 10 percent of its mass.

**Pyrolysis** [FR: Pyrolyse; ES: Pirólisis].

A thermal decomposition of materials at elevated temperatures. Charcoal is a solid product of the pyrolysis of biomass carried out at temperature above 300°C in the absence of oxygen, within a charcoal kiln.

**Recovered and used wood** [FR: Bois récupéré; ES: Madera recuperada].

Fuelwood obtained from society; wood substances or objects that have performed their intended purpose and are then utilized as fuel: used furniture, construction material, etc.

**Renewable energy** [FR: Énergie renouvelable; ES: Energía removable].

Energy produced or derived from sources that may be infinitely renewed (hydro, solar, wind) or generated by combustible renewables (sustainably produced biomass).

**Sampling** [FR: Échantillonnage; ES: Muestreo].

Sampling is the methodology in which a specific set of individuals, households, communities or other units of observation (sample) is selected from a population of interest to collect quantitative or qualitative information, without having to gather data on the entire population. It reduces the time and resources needed to undertake the study.

There are two main types of sampling: probability sampling and non-probability sampling. In probability sampling, each unit of analysis in the population of interest is given a probability of being chosen that is positive and known. This makes it possible to draw inferences from a randomly selected sample of individual units of analysis – denoted as  $n$  – to the entire population of interest – denoted as  $N$  – with known margins of error.

**Solid volume** [FR: Volume solide; ES: Volumen sólido].

Volume of individual particles; it does NOT take into account air gaps between the pieces of material. It is measured in solid m<sup>3</sup> (scm – m<sup>3</sup>), which is commonly used for timber and round wood. As a rule of thumb, 1 m<sup>3</sup> of round wood  $\approx$  1.4 stacked m<sup>3</sup> of 1-metre firewood  $\approx$  2 bulk m<sup>3</sup> of chopped fuelwood  $\approx$  3 bulk m<sup>3</sup> of wood chips (FAO, 2015b).

**Spring scale** [FR: Peson; ES: Balanza de muelle]

A type of weighing scale consisting of a spring fixed at one end, with a hook to attach an object at the other end. This device utilizes the linear relation between the applied load and the deformation of a spring (Hooke's law). It should be constantly calibrated, as the scale can stretch with repeated use.

**Stacked volume (Bulk volume)** [FR: Volume chargé; ES: Volumen apilado].

Volume of neatly stacked log wood, including the space between the wood pieces. It is measured in stacked cubic m<sup>3</sup> (stcm – stacked m<sup>3</sup>) (see FAO, 2015b for more details).

**Storage** [FR: Stockage; ES: Almacenamiento]

Storage is a process required to lower the water content of wood. Wood biomass is best dried naturally in the sun and in the wind. For use in households, the water content of fuelwood should not exceed 25 to 30 percent. With proper storage, this can be achieved in less than one year.

**Wood chips** [FR: Plaque forestières; ES: Astillas de madera].

Chipped woody biomass in the form of pieces produced by mechanical treatment, with sharp tools such as knives. Wood chips have a subrectangular shape with a typical length of 0.5 cm to 5 cm and a low thickness, compared to other dimensions.

**Wood energy** [FR: Bois énergie; ES: Energía de madera].

Energy derived from woodfuel; it corresponds to the net calorific value of the fuel.

**Wood residues** [FR: Déchet de bois; ES: Residuos de madera].

Other wood processing co-products. It includes wood waste and scrap that cannot be used as timber, such as sawmill rejects, slabs, edgings and trimmings, veneer log cores, veneer rejects, sawdust, residues from carpentry and joinery production.

**Woodfuel** [FR: Combustibles ligneux; ES: Combustibles de madera].

All types of biofuels originating directly or indirectly from woody biomass. Woodfuel is a subcategory of biofuels, which in turn constitute a subcategory of renewable energy sources (FAO, 2004). It includes solid, liquid and gaseous products. For the purposes of this study, only solid woodfuel (fuelwood and charcoal) is considered, while black liquor, pyrolytic oil and other liquid and gaseous products are not taken into account.

**Woody biomass** [FR: Biomasse ligneuse; ES: Biomasa leñosa]

Biomass from trees, bushes and shrubs.

# Annex 5

## Examples of flashcards

### TYPES OF KILN: EARTH PIT





## TYPES OF KILN: EARTH MOUND



## TYPES OF KILN: EARTH MOUND WITH CHIMNEY (CASAMANCE)





## TYPES OF KILN: BRICK KILN



## TYPES OF KILN: STEEL KILN





## SOURCE OF WOOD: NATURAL FOREST



## SOURCE OF WOOD: FOREST PLANTATION



## TYPES OF HEATERS: GAS HEATERS



## TYPES OF HEATERS: ELECTRIC HEATER



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