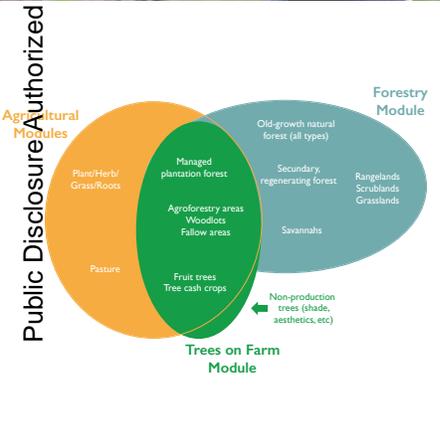
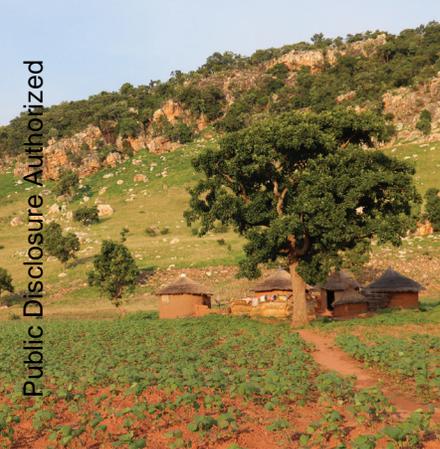


Trees on Farms: Measuring Their Contribution to Household Welfare

A Guidebook for Designing Household Surveys

Daniel C. Miller, Juan Carlos Muñoz-Mora, Alberto Zezza, and Josefina Durazo



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ABOUT LSMS

The Living Standards Measurement Study (LSMS), a survey program housed within the World Bank's Development Data Group, provides technical assistance to national statistical offices in the design and implementation of multi-topic household surveys. Since its inception in the early 1980s, the LSMS program has worked with dozens of statistical offices around the world, generating high-quality data, developing innovative technologies and improved survey methodologies, and building technical capacity. The LSMS team also provides technical support across the World Bank in the design and implementation of household surveys and in the measurement and monitoring of poverty.

ABOUT THIS SERIES

The LSMS Guidebook series offers information on best practices related to survey design and implementation. While the Guidebooks differ in scope, length, and style, they share a common objective: to provide statistical agencies, researchers, and practitioners with rigorous yet practical guidance on a range of issues related to designing and fielding high-quality household surveys. The series aims to achieve this goal by drawing on the experience accumulated from decades of LSMS survey implementation, the expertise of LSMS staff and other survey experts, and new research using LSMS data and methodological validation studies.

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ABBREVIATIONS AND ACRONYMS

CAPI	Computer-Assisted Personal Interview
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CGIAR	Consultative Group on International Agricultural Research
CIFOR	Center for International Forestry Research
CSA	Climate Smart Agriculture
FAO	Food and Agriculture Organization of the United Nations
GPS	Global Positioning System
ICRAF	World Agroforestry Center
IFRI	International Forest Resources and Institutions research network
IPCC	Intergovernmental Panel on Climate Change
L&MICs	Low- and Middle-Income Countries
LSMS	Living Standards Measurement Study
LSMS-ISA	Living Standards Measurement Study – Integrated Surveys on Agriculture
NBS	National Bureau of Statistics
NSO	National Statistical Office
OECD	Organization for Economic Co-operation and Development
PROFOR	The Program on Forests
SDG	Sustainable Development Goals
ToF	Trees on Farms
UN	United Nations

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EXECUTIVE SUMMARY

This Guidebook presents a module template for integrating information on trees on farms and agroforestry practices into multi-topic and agricultural household surveys in low- and middle-income countries (L&MICs). It provides a toolbox for survey practitioners—national statistical organizations, government ministries and agencies relevant to agricultural and environmental issues, non-government and civil society organizations, research institutions, private sector actors, and other stakeholders—to improve understanding of the contribution of trees on farms to household welfare and livelihoods. The guidebook also provides insights into data collection that can be used in relation to assessing agroforestry and climate smart agriculture practices and impacts. Implementation of the module presented here will generate information that decisionmakers, researchers, and others can use to understand the stock of trees on farms and links between on-farm trees and household welfare.

Trees on farms are widespread across the developing world and provide a range of socio-economic and environmental benefits. Half of agricultural land in L&MICs is estimated to have at least 10 percent tree cover, representing nearly a billion hectares of land and more than 800 million people. These on-farm trees range from sporadically occurring trees to areas dominated by a single tree crop, through large forest-like stands. These trees on farms perform important ecological functions that deliver environmental benefits such as erosion control, carbon sequestration, and biodiversity conservation. Trees on farms are also key to many rural livelihoods. They have been shown to support increased agricultural yields, boost incomes, and improve dietary diversity, among other benefits. As such, trees on farms are key to advancing multiple international development goals.

The role and contribution of trees on farms underscores the importance of reliable information on their prevalence and management as well as their links to livelihoods and broader economies. Yet such knowledge remains lacking, particularly at the national scale where many policy decisions relating to land use are made. As a result, trees on farms are often left out of forest-related and agricultural statistics, natural resource assessments, policy, and legislation.

This guidebook is designed to help address this knowledge gap. It presents a questionnaire template to collect information on trees on farms and describes how to use it. The questionnaire module gathers together in one place relevant questions from existing multi-topic household survey questionnaires, other topical modules (e.g. on forestry) and other resources related to agroforestry and on-farm trees. It integrates lessons learned from the implementation of tree- and forest-related questions in the context of multi-topic household surveys in countries across Africa, including Ethiopia, Malawi, Mali, Niger, Nigeria, Tanzania, and Uganda. This specific module was field-tested in Mali in early 2018.

This trees on farms (ToF) module is designed to complement existing modules on agriculture, forestry, and livestock, among others. Questions from the ToF module can be directly inserted into these existing modules or adapted according to need and context. This guidebook provides information on how the module may be used in these different ways.

The ToF module has two main objectives:

- Generate basic statistics for key variables related to trees on farms and agroforestry, including on cultivation, management, and use of different kinds of trees on farms; and
- Measure the contribution of trees on farms to household assets and income.

The module can be used to collect information in the following domains:

- The stock and management of trees grown for production purposes, including cash crops, fruit, timber, woodfuel, and other products;

- The stock and management of on-farm trees that may not have a direct productive function, such as trees grown for shade or aesthetic reasons;
- Use of trees for energy and construction; and
- Sale and consumption of tree-related products.

Information on the stock of trees on farms, the inputs needed to grow them, and associated values enables calculation of a measure of income from trees on farms. Together with information from a full socio-economic household survey, this measure makes it possible to quantify the contribution of trees on farms to the household economy.

Gender is a cross-cutting topic in the module. Ownership, management, and production and sale of products derived from trees on farms often varies according to gender. Questions aimed at capturing these distinctions are throughout the module.

The questionnaire presented here is adaptable to different stakeholder interests and capacities. It includes three main formats. The first is a short version with 23 questions that can be implemented as part of an already existing survey, where users want to have a general overview of the presence and contribution of trees on farms. The second is a standard version, comprising just under 100 questions. It adds to the short version by allowing for collection of more comprehensive data on the management and uses of on-farm tree products and services. This version enables a more complete understanding of the role of trees on farms in the household economy. Finally, an extended version provides a full set of questions that can be tailored to capture detailed data on additional dimensions of the prevalence, management, use, and benefits of both trees on farms and forestry.

Users should consider all three questionnaires as templates that can be expanded, reduced, and adapted to meet specific data and statistical needs. This is essential for developing survey questionnaires that effectively respond to the information needs of stakeholders and decisionmakers.

I. Introduction

This guidebook presents a questionnaire module template and related information to facilitate data collection of trees on farms in multi-topic and agricultural household surveys in low and middle-income countries (L&MICs). It offers a practical toolbox for improving the understanding of the contribution of trees on farms to household welfare and livelihoods. The guidebook also provides insights into data collection in relation to the agroforestry and climate smart agriculture practices and impacts. Implementation of the module presented here will generate information that decisionmakers and survey practitioners can use to understand the stock of trees on farms and the links between on-farm trees and household welfare.

Rising food prices, rapid urbanization, robust economic growth, and widening inequality (among other changes) over the past decade have fundamentally transformed the environment in which agriculture operates in developing countries. These changes affect not only farmer cropping patterns and livestock management practices, but also the role natural resources (both cultivated and uncultivated) play in their livelihoods.

Natural forests and environmental incomes typically recede as populations grow and land pressures increase (Lambin and Meyfroidt 2011; Angelsen et al., 2014). On-farm tree planting has sometimes compensated for lost forest ecosystem services (Place, Garrity, Mohan, & Agostini, 2016) and trees on farms have been shown to provide a significant source of income (Miller, Muñoz-Mora, & Christiaensen, 2017). Further, the demand for tree products – such as fruits for dietary diversification and timber for construction – are also boosted by increasing incomes and urbanization, providing an additional impetus to on-farm tree cultivation. On-farm trees also play a key role in many climate smart agricultural approaches (FAO, 2013; World Bank, 2017).

However, an estimated doubling in total world food production is needed over the next few decades in order to ensure food security, especially in fast-growing human populations

areas across the developing world (IAASTD, 2009; Godfray et al., 2010; The Royal Society, 2009; FAO, IFAD, & WFP, 2015; The Government Office for Science, 2011). As world food demand grows and population density increases, the opportunity cost of land will also increase, and on-farm tree planting may also face greater competition from crop cultivation. Indeed, the global trend toward industrial intensification of agriculture is driving tree cover loss not only in forest areas (Hansen et al., 2013; DeFries, Rudel, Uriarte, & Hansen, 2010) but also in existing agroforestry systems (Waldron, Justicia, & Smith, 2015; Siebert, 2002; Fischer, Zerger, Gibbons, Stott, & Law, 2010).

In the face of these changes, knowledge of the prevalence and nature of on-farm trees as well as their socio-economic and environmental contributions is especially important. Yet such knowledge remains lacking, particularly at the national scale where many policy decisions relating to land use are made (Miller et al., 2017). Trees on farms, particularly those that do not yield cash crops, are often overlooked in research and policy on agriculture. Trees are usually considered the domain of forestry. However, forestry as a field is largely focused on trees in forests rather than outside them. At the same time, the focus in agriculture is usually on annual (or traditional cash) crops. The organization of extension and other services often reflects this division, with agriculture and forestry typically separated into different institutions (Foresta et al., 2013). As a result of this institutional separation, trees on farms are usually left out of statistics, natural resource assessments, policy, and legislation for both forestry and agriculture (Miller et al., 2017).

This guidebook is designed to help address this knowledge gap. It presents a module template to collect information on trees on farms and describes how to use it. The next section reviews the main ways in which trees on farms may contribute to household welfare, poverty reduction, and realization of the UN 2030 Sustainable Development Goals (UN, 2015). Section 3 presents the current state of affairs on data collection related to trees on farms in multi-topic household living

standards surveys. Section 4 states the goals of the ToF module template and describe the main data collection domains in the three versions of the module. Section 5 describes the proposed standard module in more detail, walking the reader through the specifics of the questionnaire¹ and Section 6 concludes. The standard version of the proposed ToF module (which also embeds an option for the short version) is included as an Annex.

¹ The terms “module” and “questionnaire” are used interchangeably in this guidebook. Generally, “questionnaire” is used to refer to a stand-alone survey instrument, while “module” is used to identify one part of a larger questionnaire. The ToF module template presented here can be implemented as a stand-alone questionnaire (but integrated in a survey that includes other questionnaires), or as a module in an agricultural questionnaire that includes other modules, such as those developed through LSMS-ISA on forestry, livestock, and fisheries (www.worldbank.org/lsmis).

2. Trees on Farms and the Sustainable Development Goals

Trees on farms are widespread across the developing world and provide a range of socio-economic and biophysical benefits. Half of agricultural land in L&MICs is estimated to have at least 10 percent tree cover, representing nearly a billion hectares of land and more than 800 million people (Zomer et al., 2016). These on-farm trees, which range from sporadically occurring trees to areas dominated by a single tree crop through large forest-like stands, perform important ecological functions, such as soil nutrient provision, soil erosion control, carbon sequestration, habitat for animals, and greater structural connectivity, among others (Place et al. 2016; Zomer et al., 2016). As such, they serve as a key basis for biodiversity conservation (Bhagwat, Willis, Birks, & Whittaker, 2008; Schroth & da Mota, 2013) and climate change adaptation and mitigation (Zomer et al., 2016; Mbow et al., 2014).

At the same time, agroforestry—the integration of trees with crops—can increase yields while advancing multiple international development goals (Waldron et al., 2017; Garrity et al., 2010). For this reason, high-level policy documents in many countries now explicitly call for the integration of trees into farming systems (e.g. Government of India, 2014; Government of Malawi, 2011; Republic of Kenya, 2014), and agroforestry is a critical element in realizing several of the UN Sustainable Development Goals (SDGs) (UN, 2015; Waldron et al., 2017; World Agroforestry Centre, 2017).

Agroforestry can provide basic subsistence, natural insurance, and a means to generate income and build assets for many rural households in L&MICs (Garrity et al., 2010). For example, a recent study using nationally representative, geo-referenced household survey data from five African countries collected under the LSMS-ISA initiative found that on-farm trees contributed an average of 17 percent of total annual gross income for tree-growing households and 6

percent for all rural households (Miller et al., 2017). These benefits stem from the productivity and cost-effectiveness of agroforestry systems in many contexts. A raft of research now suggests that, on average, agroforestry can lead to a doubling of crop yields (Garrity et al., 2010; Pretty, Morison, & Hine, 2003; Pretty & Bharucha, 2014; Waldron et al., 2015). The main reason for this productivity increase is the ecosystem services provided by trees, including soil improvement through nitrogen fixation, reduction of crop stress through microclimate buffering by trees, and regulation of water flows through hydraulic uplift of deep water by tree roots, among others (Reed et al., 2017).

The increased yields and dietary diversity stemming from agroforestry systems can contribute directly to advancing the first two SDGs: ending poverty and achieving food security. On-farm provision of wood can boost energy security among marginalized rural populations (SDG 7), and can also help promote equity and improve human well-being more generally (e.g. SDGs 3, 5, 10) by enabling smallholder family members (particularly women) to have more time and resources available for education and farm production rather than walk long distances to collect woodfuel (Sharma et al., 2016; Kiptot, Franzel, & Degrande, 2014). By reducing the need to cut down natural forests for woodfuel and providing habitat, agroforestry contributes to SDG 15 on ecosystem protection and restoration (Sharma et al., 2016). Finally, trees on farms can make major contributions to mitigating and adapting to global climate change (SDG 13). For example, trees on farms are estimated to add 200 million tons of carbon annually to agricultural lands and have been found to foster resilience to climatic shocks (Zomer et al., 2016; Minang, Duguma, Bernard, Mertz, & van Noordwijk, 2014; Shibu, 2009; Garrity et al., 2010).

3. Trees on Farms in Existing Household Surveys

Information on trees on farms can be collected through a variety of surveys and questionnaires. These include: agricultural censuses; agricultural and forestry surveys, including modules on forest and environmental income (Bakkegaard et al., 2016; Wunder, Angelsen, & Belcher, 2014); household income and expenditure surveys; living standards or multi-topic household surveys; and other administrative records. Population and housing censuses, service delivery surveys (e.g. from extension agencies) may also include data relating to trees on farms.

Remote sensing techniques, from satellite imagery to aerial photography, also provide information on trees on farms. Advances in remote sensing are allowing finer grained analyses of tree cover across the globe (Lausch, Erasmi, King, Magdon & Heurich, 2017; Asner et al., 2017; Burke & Lobell, 2017; Jean et al., 2016; Guan et al., 2016; Hansen et al., 2013) and can provide insights into agricultural yields (Burke & Lobell, 2017; Guan et al., 2016) and even poverty dynamics (Jean et al., 2016). Remotely sensed data forms an increasingly important complement to on-the-ground surveys and questionnaires, which remain indispensable in understanding details relating to on-farm tree management and impacts.

This guidebook focuses on multi-topic and other integrated surveys such as the Living Standards Measurement Study (LSMS) surveys. Such surveys create indicators and provide the opportunity to monitor them over time as well as build knowledge of how different aspects of household livelihoods relate to each other and result in welfare and development outcomes for different socio-economic groups. Specifically, multi-topic household surveys aim to:

- Measure poverty and well-being and understand their major determinants; and
- Provide evidence for planning, monitoring, and evaluating economic policies and social programs in relation to their impact on household living standards, especially those of the poor.

Integrating information on trees on farms with other aspects of the household economy enables decisionmakers to design and implement programs to maximize the contribution of trees on farms to poverty reduction and other socio-economic and environmental objectives.

Typically, LSMS surveys are nationally representative and also representative of at least some of the different regions in a country. The sample size can vary from about 3,000 households to more than 20,000 households but is generally kept below 8,000 to facilitate management of the data quality-control process. Surveys are conducted through face-to-face interviews, increasingly with the use of Computer Assisted Personal Interview (CAPI) technologies, and generally cover a reference period of 12 months. LSMS surveys are implemented by National Statistical Offices (NSOs), often with support from the World Bank and other development partners. Questionnaires are designed with inputs from a data user group, which includes key line ministries and other stakeholders interested in obtaining information from the survey.

For a well-designed ToF module to be implemented, it is important for relevant stakeholders with knowledge of trees on farms to share their expertise and play an active role in the survey preparation. This guidebook aims to equip such stakeholders with a tool to engage in that process.

A distinctive feature of LSMS surveys is their inclusion of several questionnaires that target information at the individual, household, and community levels. They include a household questionnaire, a community questionnaire, a price questionnaire, and, in some cases, questionnaires on agriculture, gender, fisheries, livestock, and forestry. The household questionnaire is made up of sections on education, health, employment, assets, income sources, and more. Information on agriculture is often collected via a section in the household questionnaire. It is also sometimes collected through a separate, more detailed questionnaire which includes modules on crop production, agricultural labor, the use of inputs and extension services, and some questions on trees on farms.

The community questionnaire targets information on local infrastructure, availability of public services, and distances to major markets—in general, information that is expected to vary across communities rather than across households within a given location.

Existing multi-topic household surveys include some questions relevant to trees on farms, though the information solicited often remains limited. Limited information in turn poses a barrier for investigating the prevalence of tree-related practices at the household level and their interaction with household welfare. To overcome this hurdle, researchers have taken an indirect approach using related questions that provide a broad idea of the role of trees on farms in the household. For instance, Miller, Muñoz-Mora and Christiaensen (2016) identified a range of questions relevant to trees on farms in LSMS-ISA implemented in five African countries. Four categories of tree-related questions were identified:

- **Assets, management and access to tree-related resources:** questions related to cultivation and management of different kinds of trees; access and use of timber and other tree-related products (e.g. fruit, nuts, etc.) within the household and the community;
- **Benefits from forest-related services:** questions on forest-related activities with possible economic benefits;
- **Firewood and charcoal:** questions related to access, marketing and use of firewood and charcoal within households; and
- **Governance and institutions:** questions related to local governance and management of forest resources.

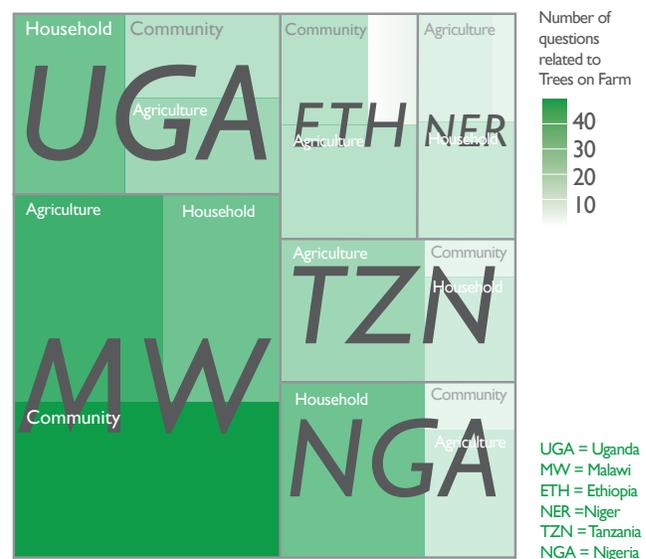
On average, LSMS-ISA in the study countries included 47 forest or tree-related questions, with the number varying widely: Malawi averaged 100 forest-related questions in the 2010-11 and 2013-14 survey rounds, but Niger only had 25. Questions about “Firewood and charcoal” were the most common (31 percent of the total tree/forest-related questions), usually relating to use as an energy source (e.g. for lighting or cooking). The second most frequent question area related to “Assets and access to resources,” with 19 percent of total forest-related questions falling into this category. Here, questions about floor and roofing materials were the most common. Very few questions were asked regarding “Governance and institutions,” though Malawi was an exception. In Malawi, questions were also asked about entrepreneurship based on forest-products (i.e. “Benefits from forest-related services”). Questions on “Assets and access to

tree-related resources” were present throughout the different modules.

Community module generally included information on the presence of forest and timber product prices, while the household module gathered information about use of timber products as the main material for construction. All the information on “Firewood and charcoal” was found in the household module. Finally, as expected, information about “Governance and institutions” was available in the community module.

Figure 1 summarizes the number of questions related to trees on farms in the different modules of LSMS-ISA surveys across the five countries in the study by Miller et al., (2016).

Figure 1 Number of trees on farms-related questions in LSMS-ISA, by module and country



Note: Survey rounds covered the years 2010-2014.

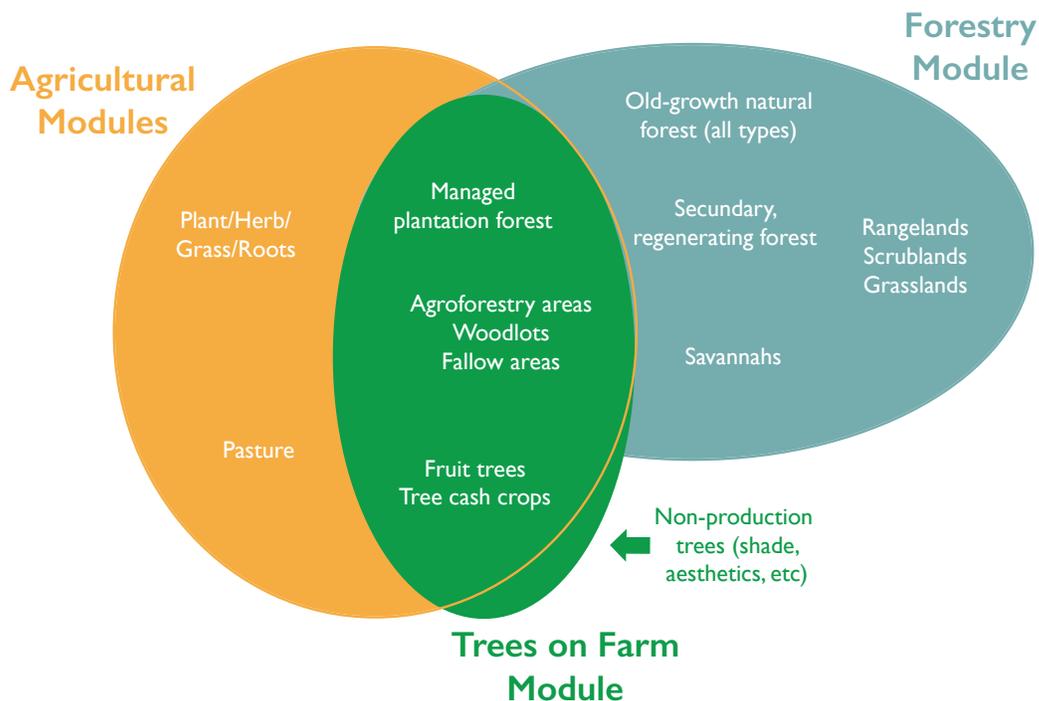
Questions such as those described above have been used as an indirect measure of the role of agroforestry on household welfare. However, the lack of the specific questions on agroforestry has posed several difficulties in understanding the dynamics of trees in broader agriculture-forest landscapes and their socio-economic and environmental contribution. For example, lack of precision in location of trees described in existing LSMS-ISA surveys made it difficult to distinguish between the services received from trees located on the farm or those from a nearby natural forest. To fill this and other gaps relating to the socio-economic contribution of forests, FAO, PROFOR, and LSMS, together with CIFOR and IFRI have developed a new forestry module (Bakkegaard

et al., 2016). The forestry module offers in-depth understanding of the role of forests and wild products in household welfare and livelihoods. Implemented on its own or integrated in existing LSMS surveys, this forestry module allows collection of information on important dimensions such as: (i) Forest changes and clearance; (ii) Forest institutions; and, (iii) Environmental Services.

The forestry module offers a comprehensive approach to the different services and benefits that a household might derive from trees in nearby forests. However, with the exception of managed plantation forest, woodlots, fallow areas, and some areas for agroforestry, on-farm trees are neglected in the forestry module, which excludes cultivated and uncultivated agricultural products from agricultural lands (e.g. cropland, pasture, crops harvested in agroforestry and silvopastoral systems, orchards, etc.).

The trees on farms module presented here therefore complements both the forestry and agricultural modules (Figure 2). It seeks to provide further information on the presence and role of trees in those plots located within agricultural land considered either as a direct productive resource (e.g., fruit trees, tree cash crops) or as unproductive yet valuable resource that may offer other types of services to households (e.g. pollination, erosion control, and other ecosystem services). The common interaction between forestry, agriculture, and agroforestry practices mean that there is necessarily some overlap among the different modules. The three modules (forestry, agriculture, and trees on farms) have been designed to be interoperable; the current module on trees on farms can stand on its own or be used in conjunction with the other two.

Figure 2 Categories of trees on farms in relation to survey modules



Note: This diagram is adapted from Figure 2 in Bakkegaard et al. (2016)

4. Module Options for Agricultural and Multi-Topic Household Surveys

This section presents three different module options – short, standard, and extended – that survey practitioners can use to capture key dimensions of trees on farms in a multi-topic household survey. It builds directly on experience using existing tree-related information in LSMS-ISA surveys as presented in Miller et al. (2016) and in creating the forestry-focused household survey module (Bakkegaard et al., 2016). The overall focus of this survey module is on the socio-economic contribution of trees on farms. Other information-gathering approaches and questionnaires would be needed to collect important information on their environmental or other contributions. Indeed, where possible, such approaches should be used in combination with the questionnaire presented herein to gain a full picture of the multi-faceted contributions made by trees on farms.

The three versions of the module differ in the level of detail that can be gauged from each, but they are similar in approach and have two main shared objectives:

- Generate basic statistics on key variables related to trees on farms and agroforestry, including cultivation, management, and use of different kinds of trees on farms; and
- Measure the contribution of trees on farms to household assets and income.

Trees on farms can impact household welfare across different dimensions and as such could potentially be relevant to multiple sections of a multi-topic household survey. An advantage of this ToF module is that it can be implemented within existing and new surveys. Indeed, the module herein is based on harmonization of already existing questions as well as select additional questions shown to be important in smaller-scale case studies.

In some cases, the ToF module could be considered a complement to the forestry module, which is recommended for use in many circumstances where the ToF module would be relevant, as it rounds out information on the different ways people may use trees in their day-to-day lives.

Most of the information collected by the ToF module builds on traditional household agriculture modules by using three main strategies: (i) inclusion of trees on farms-related options in existing questions; (ii) follow up questions to identify the specific contributions of trees on farms; and, (iii) identifying the stock of non-productive trees on farms. These strategies could be implemented with either the short version of the module, which includes key questions often missing in the traditional agricultural or forestry modules; or the extended version, which collects data on a more compressive suite of dimensions throughout the entire LSMS-ISA survey. In either case, when the module is implemented along with the standard agricultural survey, practitioners will need to carefully check each question to avoid repetition or omission of trees on farms-related options in the context of typical questions in the agricultural survey (e.g. construction material, agricultural production, etc.).

Figure 3 shows the main sections where specific trees on farms-related questions could be integrated into a household survey that includes an extended agricultural module. Community level questionnaire commonly used in LSMS-type surveys are less relevant as their questions usually refer to a nearby forest located off-farm — a dimension that is extensively covered in the forestry module (Bakkegaard et al., 2016).

The extended agricultural and household modules have an ample variety of dimensions that will provide comprehensive understanding on the stocks, as well as the role of the trees on farms in household livelihoods. Nevertheless, practitioners might be interested in only a limited set of questions, depending on their specific needs.

Table 1 provides a brief overview of the main trees on farms domains and the sections where they should be included. The trees on farms modules are initially designed as an addition to LSMS-ISA and similar questionnaires, which provide a complete overview of the agricultural, household and community environment. Nonetheless, users interested in creating a stand-alone survey on trees on farms or in implementing the

Figure 3 Standard version of a household survey for trees on farms

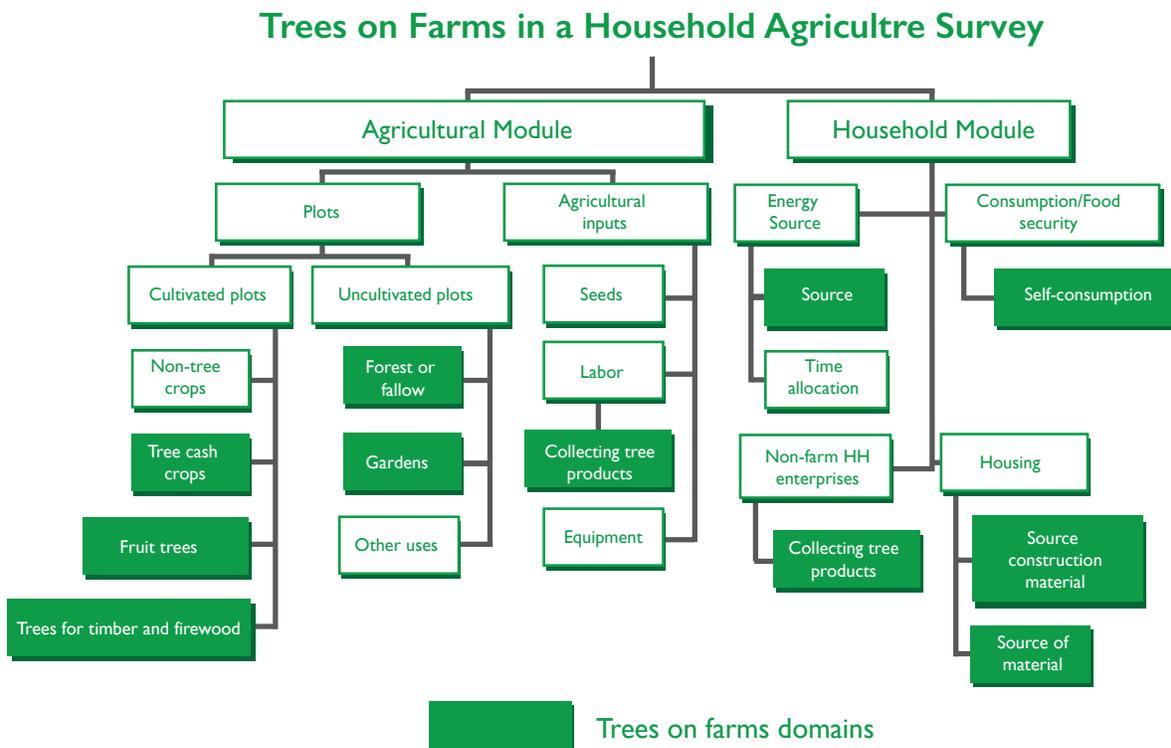


Table 1. Content summary for the Trees on Farms Module for Multi-Topic Household Surveys

Trees on Farms Domain	Survey Section	Remarks
Energy and construction material	Housing and energy	Questions are asked in the household questionnaire, as follow up in the household survey section on energy source and construction material, among others. Many household questionnaires already include energy and/or housing sections; in such cases, incorporate these forest-specific questions into those existing sections. Where similar questions already exist, be sure the question and answer options reflect the forestry-specific options herein. These questions will allow understanding on whether households use trees on farms as a main source of energy, construction, etc.
Time use	Time and household labor allocation	Questions are asked during the household questionnaire. For questionnaires that already have Time Use sections, be sure these questions are incorporated, as they allow understanding of the time spent on collection of trees on farm-related products.
Production trees on farms	Cultivated plots Tree cash crops Fruit trees Trees for timber and firewood Self-consumption (tree products)	Questions are asked for productive plots/parcels. Responses will be useful to estimate the stock of trees on farm, labor allocation, harvesting, gender roles, tree uses, and external support for on-farm tree management. Note that when used in a survey that has a food consumption section, there is the possibility of overlap on some self-consumption products. Survey designers and data analysts will need to consider this to avoid double-counting.
Other (non-production) trees on farms	Uncultivated plots Forest and/or fallow Gardens	Questions are asked for plots/parcels where trees are present but not explicitly for productive purposes. These questions are meant to capture information on non-production trees such as those in fence rows or that provide shade, among others.

module within another type of household survey can easily customize the module(s) presented here plus other modules from LSMS-ISA (e.g. crops module). When implemented as part of a larger survey, modules and placement of questions will need to be carefully reviewed to avoid repetition of questions or awkward questionnaire flow.

The three versions of the ToF module presented here are a starting point for customization, based on implementation needs and interests. The short version could be incorporated into already-established household survey where users want to have a general overview of the presence and contribution of trees on farms. The standard version adds to the short version by collecting more comprehensive data on the management and uses of on-farm tree products and services. This version enables a more complete understanding of the role of trees on farms in the household economy. Finally, the extended version uses a full set of questions to capture the broad range of dimensions through which a household may benefit from the presence, management, and use of trees on farms. It expands the detail of data collected for tree production and can include integration with separate, more detailed modules on forests, agriculture, woodfuel, and land-use tenure.

Survey practitioners are encouraged to adapt a version based on their needs, and the country's specific characteristics, taking into consideration the limitations within which each survey operation might take place. A customized trees on farms module can be designed by combining elements from the different versions, possibly adding self-tailored questions to meet additional survey needs. Table 2 provides examples of the different combinations of modules that survey implementers may want to use based on their specific interests.

KEY DEFINITIONS

All versions of this module include questions asking specific details about trees. Because there is no standard approach for determining exactly which crops should be classified as trees, a first step in preparing to implement any of these modules will be to define what does and does not qualify as a tree. Box 1 provides advice on how to deal with this dilemma. Each survey planning team should work with local tree/forestry experts to establish a definition and classification of trees that fit within their country context and survey needs.

This module is concerned with trees on non-forested land. Narrowly defined, "trees on farms" would only include trees present on land cultivated by the household (farms). However, practically speaking, the term "trees on farms" is used as shorthand to refer to all trees not in forested areas. As this guidebook and accompanying module are focused on collecting household level data, "trees on farms" refers to any trees on any land the household either uses or owns, regardless of the primary use of that land. To measure the full range of resources and benefits that trees provide, this definition encompasses both planted and naturally-occurring trees; trees on their own plot or interspersed with other cultivated land (farms); any trees on land used for pasture or other purposes; and even trees in a garden or front yard of a house. This module also collects data on woodlot and forested areas that are on the household's land. When used together with complementary forestry modules, such areas may be addressed either in the trees on farms module or the forestry module.

Table 2. Potential module implementation based on survey interest

Survey interest	ToF Module	Additional Modules			
		Household	Agriculture	Forestry	Others
The extent of trees on farms in rural household economies	Short	X	X		
More accurate overview of rural household economy in places where trees on farms are likely present	Standard or Short	X	X		
Specific interest in the economic contributions of trees on farms	Standard	X			
Detailed understanding of rural household economy in places that rely on trees on farms and forests more than agriculture	Standard	X		X	
Comprehensive understanding of rural household economy within the broader landscape context	Extended	X	X	X	Woodfuel & Land Use (optional)

BOX 1: WHAT IS A TREE?

Identifying trees on farms is not always a straightforward task. There is no standard approach to classify crops as trees. Indeed, there is no widely accepted definition of what constitutes a tree. The Encyclopedia of Life, a collaborative project that gathers scientific information for all species of life on Earth (Parr et al., 2014), provides comprehensive descriptions that can be used to categorize plants as trees or not. To qualify as a tree, the plant should be a woody perennial with an elongated stem or trunk that supports branches and leaves. The FAO defines a tree along these lines, but specifies that such a plant may have a single main stem or, in the case of coppice, several stems having a more or less definite crown (FAO, 2012). Often, trees are also defined as having a certain height, with shorter plants meeting similar criteria referred to as shrubs. The minimum height to qualify as a tree varies and the FAO advises that height limits for trees and shrubs be interpreted with flexibility, with the boundary between the two typically ranging from 5 to 7 meters (FAO, 2012). Bamboos and palms meeting the above criteria are usually classified as trees whereas plants like bananas and cassava are not. Coffee and sometimes even tea plants are classified as trees (Miller et al., 2017), but they may also be identified as shrubs depending on the height definitions used. The guidance provided here suggests that, beyond the minimum criteria defined by FAO and Parr et al., (2014) above, classification of plants as trees for trees on farms modules is best determined according to specific country context and/or survey interest.

FEATURES OF THE SHORT VERSION

The short version of the trees on farms module provides a brief overview of the stock of trees on farm, encompassing a basic set of tree-related questions for both productive unproductive plots. No additional questions are added to the household questionnaire, which includes information on construction materials, etc.

In an ideal scenario, a survey designer interested in the stock of on-farm trees might systematically implement a separate, detailed module on trees grown on farms and products obtained from them. However, such a comprehensive approach could substantially increase the duration of the interview (potentially leading to increased survey fatigue and less reliable information) and overall fieldwork (which may be beyond available survey resources). To overcome this hurdle, Miller et al. (2016) validated a classification of tree crops that can be easily implemented using an existing crop list (Annex A).

Their approach can be replicated elsewhere by pre-classifying crops that are likely to grow in a given country or region and then identifying which ones may derive from trees. The approach the authors used and advocated was to classify three main types of trees on farms in plots with cultivated crops: fruit trees, tree cash crops, and trees for timber, wood-fuel, and other non-fruit or crop purposes. The remaining crops would be classified as plants/herb/grass or roots. Based on this classification scheme, surveys can collect information on the stock of trees on farms without adding extra modules. The crop classification used by Miller et al. (2016) can be considered a reference, but classification should be modified as appropriate given national and local circumstances and definitions of a “tree.”

For *uncultivated plots*, the short version includes a few questions beyond the base agricultural module to better capture information about trees that may be found in home gardens (ornamental gardens or plots that may be omitted from agriculture land modules), forest or wooded land, and other “unproductive” areas used or owned by the household that may include trees.

Once implemented, the short version will provide a general overview of the presence of trees on farm/land across households surveyed. As this version is intended to be incorporated into existing crops modules, it means users will also capture the characteristics collected for other crops (such as land uses, cropping systems, etc.) that also pertain to the trees therein. The short version allows a broad sense of the prevalence of trees on farms, especially those in cultivated plots, but does not provide detailed information on the range of trees or their management, uses, and socio-economic contribution. This version comprises about 25 questions and is intended for surveys where there is relatively limited justification or resources for a more extensive ToF module.

FEATURES OF THE STANDARD VERSION

The standard version of the trees on farms module collects extensive information on the stock, uses, and interaction of trees on farms with the different household dimensions. It builds on the simple version with the basic classification of trees and includes more detailed tree questions at the land parcel and plot levels as well as a set of questions asked at the household level. This version can be used on its own or incorporated into standard household and agriculture household surveys.

Unlike the short version, the standard version includes information related to household livelihoods. Even though

BOX 2: PILOT TESTING THE ToF MODULES IN MALI

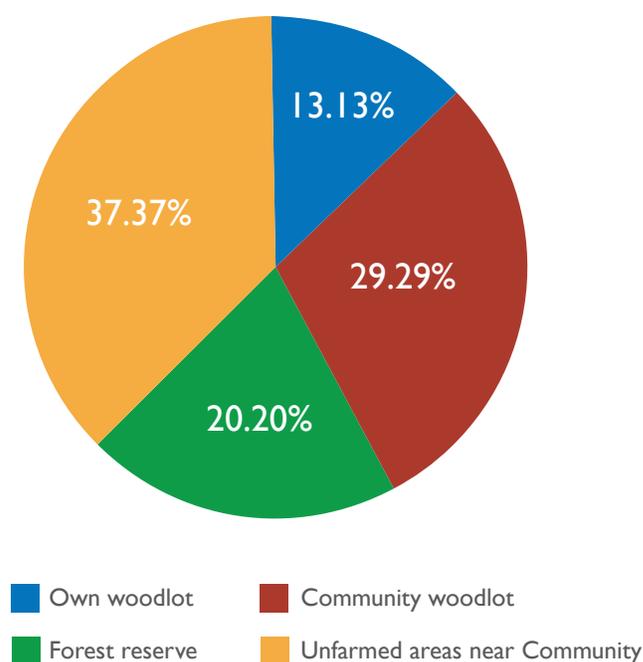
The modules presented in this guidebook were pilot tested in Mali in early 2018 as part of a national-scale survey (Enquête sur la mesure des Rendements et l'Identification des Variétés du Sorgho, ERIVaS). The survey modules were tested using a randomly selected subset of 300 households that reported having at least one parcel containing trees during the post-planting phase of the agricultural cycle. Of the 300 households, 298 responded to the survey, 264 of which harvested products from the trees on their farms. Based on the results, some questions were revised to improve the survey. Overall, the experience showed that the modules work in practice and provide some results that give a sense of what might be possible in other contexts.

For the *section on energy and construction materials*, the Mali sample shows that trees play a key role as the main source of energy and material for construction. The vast majority of households used tree products for the roof of their homes (93 percent) and used collected firewood as their main source of cooking fuel (98 percent). Firewood was collected from a variety of locations as shown in Figure 4. Results from the *time use section* of the survey module suggest that only 20 percent of individuals in the sample spent time collecting firewood. However, for these people the average number of weekly hours spent on this activity is substantial, with more than ten hours reported on average. The *production trees on farms section* shows that the land area devoted to trees for production purposes is substantial (more than three ha), but household labor is relatively minimal (less than two person-days was devoted to managing trees annually). A substantial portion of tree production contributed to household welfare, especially for nutrition purposes (64 percent of tree products reported, mainly fruits, were used to enhance nutrition) but also for sale (27 percent of tree products were either sold directly or transformed (e.g. nuts to oil, and sold). Finally, the *section on trees for non-production purposes* showed that such trees comprised a relatively small portion of land among respondents but had value for shade (33 percent of households with non-productive trees reported this value) and as a source of medicine (20 percent of households reported this value). This last section is not found in previous LSMS-ISA surveys and its results help shed new light on the non-production values trees may have for households.

members of a given household may rely on trees as part of their livelihoods, information on the source and time allocation has been traditionally neglected in LSMS-type surveys. For instance, timber and non-timber products are mentioned as important energy source for lighting or cooking as well as a material for construction, but information on the location where these materials were collected is often lacking in LSMS-ISA surveys. The standard version devotes attention to gathering additional information on potential uses of trees on farms.

For cultivated plots, the standard version includes additional questions about the characteristics of each category of tree and how they are managed. In particular, it asks about the number of trees, how they were adopted (e.g. through planting, natural regeneration, etc.), approximate area with trees, among other aspects that will provide a more complete overview of the presence and importance of trees on farms from the point of view of production. For uncultivated plots, the standard module adds a more detailed description on the uses considered unproductive and gathers information about quality of land where trees are present. The standard module also collects information on land tenure and gender dimensions.

Figure 4: Source of collected firewood in Mali field test of survey modules



Implementing the standard version, users will be able to generate detailed statistics on the presence of trees on farms in cultivated and uncultivated plots, and the monetary and non-monetary contribution of trees to household welfare. These data are absent to a significant extent in the current standard household surveys. More generally, such information on trees on farms is almost always unavailable in existing nationally-representative data sources. The standard version of the module comprises about 100 questions.

FEATURES OF AN EXTENDED VERSION

An extended version of the trees on farms module can cover a wider range of topics relating to the interaction of household livelihoods, trees on farms, forestry, and agriculture and could be used to better understand the characteristics and socio-economic contribution of trees on farms. This version should include the sections and questions in the standard version and complement them with relevant questions from the forestry module and from the agriculture modules of the LSMS-ISA questionnaires. Tree product questions can be expanded into a separate roster, allowing respondents to report information on multiple products harvested from each tree type; more information. Depending on the specific data and policy needs, the extended version can also probe further into woodfuel and land tenure characteristics, both of which have been covered in detail in recently published guidelines (GSARS, 2018 and FAO, World Bank, & UN-Habitat, 2019, respectively). Survey planners and designers should take great care when incorporating sections from a variety of modules, ensuring that the flow of questions remains accurate. Skip instructions and enabling rules will need to be revised to ensure that, even when some questions are removed and others added, each question is still asked when intended. Finally, the extended version should include a community-level questionnaire to complement data collected at the household level by gathering information on community management and governance details that may be relevant to privately held trees on farms. Box 2 presents a suggested table of elements for an extended module.

The main advantage of an extended version of the trees on farms module will be the possibility to distinguish between the tree-related services coming from nearby forests and those located on farms. Such data collection can allow analysis on the substitution of trees on farms for natural and other forests. An extended version of the module is meant for use in contexts where forests are of particular importance and decisionmakers are interested in the dynamics of land use in broader agricultur-

al-forest landscapes. Alternative options for creating an extended version entail combining the standard version of the ToF module with specific modules on land (Carletto, Gourlay, Murray, Zezza, 2016), gender (Kilic & Moylan, 2016), among others.

BOX 3: EXTENDED TOF MODULE, BUILDING ON THE STANDARD TOF MODULE WITH ELEMENTS FROM THE FORESTRY MODULE (FM), WOODFUELS MODULE (WM) AND LAND TENURE MODULE (LM)

Community Questionnaire: Forestry Module (FM)

- FM_COM_Module A: Seasonal calendar
- FM_COM_Module B: Most important forest and wild products
- FM_COM_Module C: Units and pricing
- FM_COM_Module D: Community benefits
- FM_COM_Module D1: Practices
- FM_COM_Module D2: Support
- FM_COM_Module E: Governance
- FM_COM_Module E1: Forest institutions

Household Questionnaire: Forestry Module (FM) + Trees on Farms Module (ToF) + Woodfuels Module (WM)

- A general household member roster, collecting basic characteristics of household members
- WM_2: Woodfuel (optional)
- WM_3: Charcoal (optional)
- FM_HH_Module A: Seasonal calendar (Forestry Module)
- FM_HH_Module A1: Income from forest and wild products
- FM_HH_Module A2: Other forest-related income sources
- FM_HH_Module B: Forest resources – energy, health and construction (trees on farm must be explicitly included, and can do so by merging this with ToF_Module A: Role of trees on farms in housing and energy)
- FM_HH_Module B1: Forest resource base
- FM_HH_Module B3: Forest and health
- ToF_Module B: Time use (firewood collection). Optional: incorporate these time use questions into a more detailed table of various time-use activities.

Agricultural Sections: include Standard ToF module

The Following ToF Modules can be administered on their own or merged with more detailed counterpart sections from agriculture modules such as the ones in LSMS-ISA surveys:

- LM (optional): can be incorporated into ToF_Module C below.
- ToF_Module C: General characteristics of agriculture parcels & presence of trees on farms
- ToF_Module D: Detail on crop allocation and inputs & presence of trees within each plot
- ToF_Module E: Production and Uses of Trees on farms

5. Trees on Farms Module: The Standard Version in Detail

The standard ToF module of the household survey aims to provide a complete picture of the management and use of on-farm trees at the household level, with particular reference to the contribution of such trees to household income.² The module elicits information on different kinds of trees cultivated, managed, and used within the household. It looks at seasonal dynamics and measures tree-related inputs and outputs directly and monetarily.

Survey implementers will need to tailor the timeframe appropriately for both local context and survey needs. The timeframe used throughout this module is “past 12 months”. Another option is to change the reference period to refer to the most recent growing season or “past growing season”, providing a clear definition of the calendar period covered, based on local seasonality. The timeframe should be consistent throughout this module and any agricultural modules as well.

The household is the level of observation at which the sample is drawn and interviews are conducted. Some sections collect information from household members at more detailed geographic levels (plots, parcels, etc). This module consists of five sections: (A) Trees on farms in housing and energy; (B) Time allocation of household members for firewood collection, a component of tree management; (C) General characteristics of parcels containing trees; (D) Inputs for trees on farms at the plot level; and (E) Details on Production and other uses of trees at the tree type level. The four initial sections build a complete understanding on the presence, management, and stock of trees on farms while the remaining section focuses on household livelihood dimensions.

Questions in the template module provided here can be administered as a somewhat stand-alone module or incorporated into already existing multi-topic questionnaires.

For a stand-alone module, the sections and questions can be administered in the formatted order. These topic-specific sections will need to be preceded by at least two general household survey sections: a section for interview details (location and contact information on the household plus interview tracking details) and at least a basic household member roster (list of household members with basic characteristics on each person in the household).

If the module will be part of multi-topic household survey with agriculture modules, most questions from Sections A and B can be incorporated into existing sections on Housing Characteristics, Energy, and Time Use. The four filter questions for Trees on Farms (ToF) will move to Section C (see Section A below for further guidance). The questions in the parcel and plot sections (C and D, respectively) would be merged with the same sections for agriculture. When a question from ToF is similar to one from Agriculture, ask it only once, ensuring the wording and answer options encompass the needs of both thematic areas. All other questions should be inserted where they make most sense for the flow of the interview, which may be interspersed with agriculture questions. Skips will need to be revised as appropriate to ensure questions are asked when expected. For example, the stand-alone ToF module only asks about land tenure when trees are present on a given parcels; however, in multi-topic surveys, this information will likely be collected from all parcels. Whereas agriculture surveys focus on collecting detailed information from cultivated land, a combined survey will need to collect more details on uncultivated land when trees are present. For example, agriculture sections usually collect soil characteristics only for cultivated land; when combined with the ToF module, these questions need to be asked of all land with trees, regardless of cultivation status.

² The contribution of forest related products in household income is extensively covered by the forestry module (Bakkegaard et al., 2016). In this case, the trees on farms module will strengthen information on income derived from trees on farms, especially on production plots, but it does not emphasize environmental income or other forest related income. An extended version of the module could incorporate such questions to gain a full portrait of household income in cases where they may derive income from land outside their holdings (or farmland used).

If a forestry module is also being incorporated into existing multi-topic questionnaires (such as LSMS or LSMS-ISA questionnaires), there may be further overlap with the ToF sections and their questions. Similar to the guidelines detailed above for incorporating ToF with agriculture modules, careful review is needed when merging these modules to determine the appropriate placement and enabling rules for trees on farms questions.

Deciding the placement of the first interview questions (Section A, Question 1- 4 regarding the presence of trees on land owned or cultivated by the household) will depend on the target household sample to be interviewed and the presence of additional modules, as they determine which households qualify as having “trees on farms” and which should be interviewed and/or asked the forest-related questions. In the order presented in the template, only households that report having trees on farms will be asked any of the ToF module. However, if the module is part of a more extensive questionnaire, there may be interest in asking questions in Section A and B to all households. In this case, these questions (Sections A and B) will need to be incorporated into already existing similar sections and the main trees on farms filter questions should be moved to the start of Section C. If the multi-topic survey being used includes an agriculture section, then several questions in Sections C and D would likely be asked for all parcels and plots (regardless of tree presence). In these cases, the trees on farms filter questions could be incorporated into the initial agriculture section (usually a parcel roster); a positive response on this question can then “enable” the inclusion of the trees on farms parcel and plot questions that have been integrated into the relevant agriculture sections as well as the stand-alone section on Tree Production and Uses (Sections E). Questionnaire skip patterns will need to be reviewed carefully to ensure that the trees on farms questions, when spread throughout a larger questionnaire in this way, are implemented correctly.

Section A — The role of trees on farms in housing and energy

This section collects information at the household level on the use of timber and other products gathered from trees on farms as a source of fuel for lighting and cooking as well as a material for construction. This module can be asked independently or be integrated within an existing household characteristics section.

- Q1-Q4: These are designed to establish the presence of any trees on farms, which in turn determines the use of

the ToF module. It is important that enumerators understand this includes both productive and non-productive trees. When a trees on farms module is implemented within a more extensive household module some of these questions may not be relevant or may already be included in existing sections. In such cases, practitioners need to include the new questions where appropriate for overall flow. Three examples of placement options are:

- For surveys that plan to interview *only households that have trees on farms*: this set of questions should be at the start of the questionnaire (as in the version provided).
 - For surveys that (a) plan to include a broader sample of households, some of which are expected to have trees on farms, and (b) do not include more detailed agriculture data collection: this set of questions would be asked at the start of Section C. Sections A and B would be asked of all households, as it is possible for households to use trees in these ways even without having access, ownership, or user rights to land with trees.
 - For surveys that (a) plan to include a broader sample of households, some of which are expected to have trees on farms, and (b) where trees on farms questions will be incorporated into more detailed agriculture section: Q1 will likely already be part of the agriculture section; Q2 should be added to ensure capturing non-productive trees on less/non-productive parcels; Q3 and Q4 can be asked in sequence, or at the start of tree-specific questions. In this case, skip instructions should be revised to accommodate the merging of agriculture and trees on farms modules, as many of the questions in the parcels and plots section may apply to both trees on farms and agricultural crops.
- Q5-Q10: These questions collect information on the main construction material used in the household. In case of material based on timber, a follow up question gathers information on the main source, putting special attention on the use, and type of on-farm trees related products.
 - Q11-Q12: These questions gather information on the main source of fuel for lighting and cooking.
 - Q13-Q17: These questions gather information on the collection of firewood as fuel. In particular, they collect more specific information on the distance (in time) and location of the collection.

For further background and guidance on woodfuel questions, including options for collecting more detailed data on this topic, refer to the *Guidelines for the Incorporation of a Woodfuel Supplementary Module* (GSARS, 2018).

Section B – Time allocation in relation to tree products

This section collects information at the individual level on the time-use for firewood collection both on-farm and off-farm.

- Q1-Q2: These questions ask who is responding on behalf of each household member. The HH Roster ID Codes refer to codes assigned to each household member, usually as part of a standard household members roster section. If such a section will not be administered as part of the survey, such IDs can be assigned to each household member at this point.
- Q3-Q4: These questions collect information on the number of hours spent collecting firewood off- and on-farm.

Section C – General characteristics of parcels containing trees on farms (Parcel Roster)

This section gathers basic information on the parcel(s) that comprise the household's "farm", which for the purpose of these tree-related questions includes any land the household either owns or uses, whether or not such land is being cultivated. This section includes questions about land tenure and ownership, including gender dimensions, and basic location information on each parcel. Parcels can be comprised of one or multiple plots. A parcel is typically defined as one contiguous piece of land, while a plot is usually a contiguous piece of land under one land/soil management regime. Therefore, respondents are also asked about the number of plots on each parcel, which in turn become the observation level of the subsequent section.

- Q1: This question asks for a basic description or name of each parcel, which will be used in following questions to help guide the flow of questions.
- Q2: This question gathers information on the person who is responding for each parcel.
- Q3: This key question asks about the presence of trees on farms in a given parcel. If no parcel has any trees on farms (productive or otherwise), then the trees on farms

module ends here. However, if the respondent answered affirmatively to the trees on farms filter questions at the start of Section A, interviewers should expect at least one parcel per household.

- Q4: This question asks respondents to estimate the size of the entire parcel. Local/traditional area unit codes (ex: football field, pitch, etc.) should be customized to the country context. In some cases, this self-reported information could be checked against the GPS coordinates in Q5. Information on location and size will be of particular interest for efforts to combine household-reported information on trees on farms with satellite data.
- Q5: This question gathers the GPS coordinates of each parcel or, when possible, actual area measurement of the parcel, usually collected by walking the parcel perimeter with GPS. This would require that the interviewer visit each parcel, so inclusion should take into account the interests and practical needs of the survey project.
- Q6-Q7: These questions are about the relative location of the parcel with respect to the household, road, and market. This information can be useful to understand the location's role in determining uses of a particular parcel for trees on farms or for other productive reasons.
- Q8-Q11: These questions gather information on land tenure – ownership of the parcel, type of property rights, specific household members with ownership status, and types of ownership documentation. Further explanation of land tenure questions, including options for collecting more detailed data on this topic, can be found in guidebook *Measuring Individual's Rights to Land* (FAO, WB, & UN-Habitat 2018). Answer codes for Q8 and Q11, as well as named agencies and examples in Q10, should be customized to the specific country context.
- Q12: Following up on the tenure structure, this question collects information about the specific household member with usage rights for each parcel. This can enable understanding of gender dimensions, which have been shown to be important in relation to trees on farms (Rocheleau & Edmunds, 1997; Meijer, Sileshi, Kundhlande, Catacutan, & Nieuwenhuis, 2015; Schroeder, 1999).
- Q13-14: These questions establish the number of plots within each parcel that contain trees on farms. The subsequent sections will only be enabled for plots with trees.

Section D – Detail on inputs for trees on farms at the plot level (Plot Roster)

This section collects information on each plot (sub-parcel) that contains trees on farms. It determines whether or not a given plot is cultivated and asks follow-up questions for cultivated parcels regarding land management, inputs, and soil quality. More specific information on individual tree species and their presence is collected in Sections E.

- Q1a&b: These questions collect respondent info and self-reported information on the size of each plot. Note that the sum of the plots on a given parcel should be no greater than the area reported for the parcel. (It is not necessary that they equal the parcel area, in part because only plots with trees are reported in this section). Local/traditional units should be customized to the country context.
- Q2: This question collects information about the current status of the plot. Based on the response to this question, Q3 – Q11b are only asked when the plot of land is cultivated.
- Q3-Q5: These questions collect information about the decisionmaker(s) at the plot level. This data can be used to understand gender dynamics.
- Q6-Q11: These questions gather information on the pattern of cropping used in this specific plot during the past 12 months plus details on any fallow periods during the past 10 years. Note that “the past 10 years” reference period in Q9 should not change with the overall reference period of the survey (12 months, past season, etc.).
- Q12: Asks the respondent about the criteria they use to rate the quality of their land. Interviewers should avoid reading the answer options on this question, as doing so may bias the respondent’s answer.
- Q13-Q19: These questions gather detailed information on soil quality, slope and the main productive characteristics of the plot’s land. Interviewers should avoid reading the answer options for Q19, as doing so may bias the respondent’s answer.
- Q20-Q22: These questions gather information about the use of fertilizer; in particular, the use of trees on farms-related product as a main source of organic fertilizer.
- Q23: This question asks about the role of trees on a given plot, which determines whether the final set of questions

in this section should be asked.

- Q24-Q28: These questions collect information on household and non-household labor allocated to each specific plot. They are only asked when the plot has productive trees.

Section E – Production and other uses of trees by type

This section is designed to gather general information on the stock of trees on farms – both productive and unproductive – on land owned or used by the household. Non-production trees have been traditionally neglected in LSMS-ISA and similar style surveys, even though they can offer a variety of services to households, such as medicine and decoration, among others. For productive trees, additional information is collected regarding the area cultivated with trees, the type of trees cultivated and managed, tree ownership and management, and disposition of cultivated tree products. The reference period for this section is the time of interview, representing a snapshot of the current status of all trees reported on the farms. The reference period for products harvested from trees on farms is the past 12 months; depending on the recall period of other sections, and the local context, this could be changed to the past growing season or a specific calendar period. Using the baseline trees classification, this section will classify the trees in a cultivated plot. Each line corresponds to a different tree/crop. Importantly, having a list of some common trees in the survey area/country in local language(s) will be useful as an aid for enumerators to provide examples to help respondents recall potential trees on their land.

- Q1-Q2: These questions ask respondents to list the different types of trees on each plot, identifying each by species or local name, as well as by use-type category (cash crop, fruit, fuel, fodder, etc.). It is imperative that the list of code for species/types of tree is carefully reviewed and edited by the survey team together with local forestry experts to ensure it is tailored to the country context. It should include common/familiar names of trees that respondents may be most familiar with, in order to facilitate easier reporting during the interview.
- Q3-Q5: These questions collect information on the age and number of trees on farms and the portion of area allocated to trees on farms on a given plot.
- Q6: This question collects information on whether these trees were planted or were naturally occurring.

- Q7-Q9: These questions gather information on the seeds for trees on farms and about any technical support received for managing and planting trees on farms.
- Q10: Asks if the specific tree type on this plot is used for production purposes. "Production purposes" is explained to the respondent as harvest, collection, or use of any products from the trees. Productive and unproductive trees have distinct follow-up questions from this point.
- Q11-12: For trees that are not currently being used for production, these questions collect information on whether they have ever been used for production. If there is interest in understanding more about formerly-productive trees, follow-up questions could be added, such as what products were last harvested (similar to Q16) and why they are not currently being used for production.
- Q13: This question collects information on the household's main uses for the (unproductive) trees present in this plot.
- Q14-Q15: This question collects information on activities the household does to manage the trees present on each plot.
- Q16-Q19: These questions gather information on production periods for products harvested from each tree type, as well as production quantities for the primary product harvested and decision-making roles on the production obtained from trees on farms. This information is particularly relevant for trees such as fruit trees or tree cash crops where non-timber products could be obtained. In the case of tree plantations, these questions will be related to timber products. All subsequent questions ask specifically about the main product harvested from each tree type. Local/traditional non-standard unit codes are recommended to help respondents report quantities in whatever units they are most familiar with and should be customized to the country context.
- Q20-Q21: These questions gather information on the losses that occurred before harvesting. The first question inquires about the presence of any loss and the second on the main cause(s).
- Q22-Q27: These questions gather information on the share of the main tree production used within the household for self-consumption.
- Q28-Q33: These questions collect information related to the sale of the main tree product or derivatives of these products. Only total value (and not quantity) is asked in this version because Q28, as written in this version, includes both primary and processed versions of the tree product which may have different weight profiles. Survey teams that are also interested in analyzing unit prices of harvested products should split Q28 into two separate questions for primary and processed [TREE product] and for each ask follow-up question on quantity sold and value of the quantity sold.
- Q33-Q35: These questions gather information on storage methods and the main uses for the main tree product.

6. Conclusions

Rural livelihoods in developing countries are diverse and dynamic. Realizing major policy goals and international commitments such as poverty reduction, food security, climate change mitigation, and biodiversity conservation, among others, requires reliable information about people living in rural areas and their livelihoods. Available evidence suggests the importance of trees on farms as a source of income, but more data is needed for public, private, and community actors to develop effective strategies for enhancing on-farm tree management and investment. There is also a particular need for national-scale information on this contribution.

Recognizing these needs, and the potential value of trees on farms, the LSMS agriculture surveys have been expanding coverage to include data collection of data on trees on farms. Multi-topic household surveys provide an important platform to address this lack of information, as they are implemented throughout the world and, as demonstrated by the experience of the LSMS-ISA program, can be a cost-effective vehicle for collecting data on livelihoods. Though many such surveys already collect data on agriculture and on forests, trees on farms have often been overlooked as they are not clearly or entirely within the domain of either. This guidebook and the module on which it is centered will aid practitioners in expanding household survey coverage to include quality data collection of trees on farms.

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ANNEXES

Annex A: Sample Classification of Trees on Farms by Type

CROP	Type of Tree
Agbono (Oro Seed)	Fruit Tree
Apple	Fruit Tree
Avocado	Fruit Tree
Bilimbi	Fruit Tree
Bitter Kola	Fruit Tree
Bread Fruit	Fruit Tree
Buya	Fruit Tree
Cherry (Agbalumo)	Fruit Tree
Cinnamon	Fruit Tree
Coconut	Fruit Tree
Custard Apple	Fruit Tree
Date Palm	Fruit Tree
Durian	Fruit Tree
Fig	Fruit Tree
Gishita	Fruit Tree
God Fruit	Fruit Tree
Grape Fruit	Fruit Tree
Guava	Fruit Tree
Jackfruit	Fruit Tree
Kola nut	Fruit Tree
Kola nut Shelled	Fruit Tree
Kola nut Unshelled	Fruit Tree
Lemon	Fruit Tree
Lime	Fruit Tree
Malay Apple	Fruit Tree
Mandarin/Tangerine	Fruit Tree
Mango	Fruit Tree
Masau	Fruit Tree
Oranges	Fruit Tree
Paw Paw	Fruit Tree
Peaches	Fruit Tree
Pear	Fruit Tree
Plum	Fruit Tree
Pomegranate	Fruit Tree
Pomelo	Fruit Tree
Pomme Du Sahel	Fruit Tree

CROP	Type of Tree
Black Pepper	Tree Cash Crops
Cashew	Tree Cash Crops
Cashew Fruit	Tree Cash Crops
Cashew Nut	Tree Cash Crops
Castor Beans	Tree Cash Crops
Chat	Tree Cash Crops
Clove	Tree Cash Crops
Cocoa	Tree Cash Crops
Cocoa Beans	Tree Cash Crops
Cocoa Pod	Tree Cash Crops
Coffee All	Tree Cash Crops
Dry Leaves (Kuka)	Tree Cash Crops
Gomme Arabique	Tree Cash Crops
Gum Arabic	Tree Cash Crops
Iyere	Tree Cash Crops
Locust Bean	Tree Cash Crops
Macadamia	Tree Cash Crops
Monkeybread	Tree Cash Crops
Moringa	Tree Cash Crops
Oil Palm	Tree Cash Crops
Palm Kernel	Tree Cash Crops
Ronier	Tree Cash Crops
Rubber	Tree Cash Crops
Rubber Lump	Tree Cash Crops
Rubber Sheet	Tree Cash Crops
Shea Nuts	Tree Cash Crops
Tea	Tree Cash Crops
Three Leave Yam	Tree Cash Crops
Bamboo	Trees for timber and woodfuel
Black Wattle	Trees for timber and woodfuel
Fence Tree	Trees for timber and woodfuel
Firewood/Fodder	Trees for timber and woodfuel
Kapok	Trees for timber and woodfuel
Mahogany	Trees for timber and woodfuel
Natural Forest Trees	Trees for timber and woodfuel
Other Forest Trees	Trees for timber and woodfuel

Rambutan	Fruit Tree
Star Fruit	Fruit Tree
Tamarind	Fruit Tree
Walnut	Fruit Tree

Data source: Miller, Muñoz-Mora, Christiaensen 2017.

Plantation Trees	Trees for timber and woodfuel
Timber	Trees for timber and woodfuel

Annex B: Trees on Farms Module Template

Trees On Farm Module		
For detailed explanation and instructions regarding the content of this module, see Section 5 of the guidebook <i>Trees on Farms: Measuring Their Contribution to Household Welfare</i>		
	STANDARD VERSION - CONTENTS	SHORT VERSION - NOTES
SECTION A	Household - Housing and Energy	Q1-Q4 move to Parcel Roster
SECTION B	Household - Time use (firewood collection)	Incorporate Energy Section or Individual-level Time Use Section
SECTION C	Trees - Parcel Roster	Incorporate into Agriculture Land/Parcel Roster section if using; otherwise, stand alone section
SECTION D	Trees - Plot Roster	Incorporate into Agriculture Plot Roster section if using; otherwise, stand alone section
SECTION E	Trees - Production & Uses	Stand alone section
<p>Throughout the module, questions forming a short version are highlighted in green. For the short version, some sections can be incorporated into other existing household survey sections.</p>		

SECTION A: HOUSING & ENERGY

1	In the past 12 months, did anyone in this household cultivate, own or hold use rights for any land, either alone or with someone else?	<input type="checkbox"/> Yes...1 <input type="checkbox"/> No...2					
2	In the past 12 months, did anyone in this household have access to/use land for activities other than cultivation, such as a yard, decorative garden, etc?	<input type="checkbox"/> Yes...1 <input type="checkbox"/> No...2	>> if Q1=2 also, then >>END TREES ON FARMS MODULE				
3	Are there any trees on any of this land? This can include naturally-occurring or planted trees, used for any purpose - fruits, cash crops, fodder, fuel, fertilizer, etc. - including those that are ornamental or not used at all.	<input type="checkbox"/> Yes...1 >> Q5 <input type="checkbox"/> No...2					
4	Were there any trees on this land in the past 12 months?	<input type="checkbox"/> Yes...1 <input type="checkbox"/> No...2	>> END TREES ON FARMS MODULE				
	Is your dwelling constructed from any materials derived from trees? Yes 1 No 2 (▶ 11)	<input type="checkbox"/> Yes...1 <input type="checkbox"/> No...2	What is the main tree-related material used in the roof of the primary dwelling? Wood..... 1 Bamboo..... 2 Leaves..... 3 Other..... 4	Is tree-related material used in the roof of the primary dwelling? Yes 1 No 2 (▶ 10)	What is the main tree-related material used in the outer walls of the primary dwelling? Wood..... 1 Bamboo..... 2 Both..... 3 Other..... 4	Is tree-related material used in the outer walls of the primary dwelling? Yes 1 No 2 (▶ 8)	What is your main source of lighting fuel? Collected firewood..... 1 Purchased firewood..... 2 Grass..... 3 Paraffin..... 4 Electricity..... 5 Gas..... 6 Battery/dry Cell (torch)..... 7 Candles..... 8 Battery/dry Cell (car)..... 10 Other, Specify..... 11
5		9	10	8	7	6	11

SECTION A: HOUSING & ENERGY (CON'T)

What is your main source of cooking fuel?	INTERVIEWER / PROGRAMMER NOTE:	Does your household ever use firewood for fuel?	Does anyone in your household ever collect firewood?	Where is firewood usually collected?	How long does it take to walk from your dwelling to where firewood is usually collected?
Collected firewood.....1 Purchased Firewood.....2 Paraffin.....3 Electricity.....4 Gas.....5 Charcoal.....6 Crop residue.....7 Saw dust.....8 Animal waste.....9 Other(specify).....10	IF Q11 = 1 OR Q12=1 >> Q15 IF Q11 = 2 OR Q12=2 (AND NEITHER = 1) >> Q14	YES.....1 NO.....2 (▶ NEXT SECTION)	YES.....1 NO.....2 (▶ NEXT SECTION)	Own farm, yard, woodlot.....1 Other farm/agriculture areas.....2 Natural forests.....3 Forest plantations.....4 Bush, riverbanks, other natural/wild areas.....5 Urban areas, roadside, construction site, dumps.....6 Other (Specify).....7	[ESTIMATE TIME TO WALK ONE DIRECTION] AMOUNT MINUTE...1 HOUR....2 UNIT 16 17

SECTION B: TIME USE & LABOR

INTERVIEWER /PROGRAMER NOTE: THIS SECTION FOR AGES 5+

ID CODE	Is the respondent reporting for him/herself? Yes ... 1 (▶3) No ... 2	Who is responding on behalf of [name]? HH ROSTER ID CODE	In the past 7 days, how many hours did you spend collecting firewood (or other woodfuel) <u>from all</u> <u>locations?</u> hours	In the past 7 days, how many hours did you spend collecting firewood (or other woodfuel) <u>on land</u> <u>owned or used by you or your</u> <u>household?</u> hours
	1	2	3	4
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

SECTION C: PARCEL ROSTER

Now we will ask about land used or owned by the household.

PARCEL ID	PARCEL NAME	RECORD THE ID OF THE RESPONDENT FOR THIS PARCEL	Are there any trees on this Parcel? These can be naturally-occurring or planted trees, used for any purpose (fruits, cash crops, fodder, fuel, fertilizer, etc.) and those that are ornamental or not used at all. Yes...1 No.....2 (▶ NEXT PARCEL)	What is the area of [PARCEL]? UNIT CODES FOR RESP. ESTIMATE Hectares1 Acres2 Square meters.....3 Local unit 1.....4 Local unit 2.....5	How long does it take to walk from the homestead to this parcel? Less than 15 min...1 15 -30 mins.....2 30 -60 mins.....3 1 -2 hours.....4 over 2 hours.....5	What is the distance from [PARCEL] to:				
		HH ROSTER ID CODE		RESPONDENT ESTIMATE	GPS MEASURE	HOME KM	ROAD KM	MAR-KET KM		
				QUANTITY	UNIT	AREA IN ACRES				
1		2	3	4a	4b	5	6	7a	7b	7c
2										
3										
4										
5										
6										
7										
8										

SECTION E: PRODUCTION & USES [TREES] con't

PRODUCTION		HARVEST																
Who provided external support? [list all that apply]	In the past 12 months, did your household harvest, collect, or use any products from the [TREES]? This can include wood, branches, leaves, resin/sap, fruit, etc.?	Has your household ever harvested, collected, or used any products from the [TREES]? This can include wood, branches, leaves, resin/sap, fruit, etc.?	When was the last time products were harvested from [TREE]?	What are the main uses of these trees? (LIST UP TO TWO)	Has your household undertaken any activities to manage these trees, such as planting, pruning, fertilizing, etc.?	Which activity has your household done?	In the past 12 months, which products did your household harvest or intend to harvest from the [TREES]? ASK EACH ONE, CODE ANSWER 1=YES 2=NO. IN CAPITAL THIS CAN BE A LIST OF YES/NO QUESTIONS											
1.. Government agency	2.. NGO	3.. Community organization	4.. Private company	5.. Other (specify)	Yes...1 No...2 ▶ 13a	YEAR	USE 1	USE 2	14	15	A	B	C	D	E	F	G	
					Yes...1 No...2 ▶ 13a	12	13a	13b	14	15	16							
9	10	11	12	13a	13b	14	15	16										

- A. Wood
- B. Branches/sticks
- C. Leaves
- D. Sap/resin
- E. Flowers
- F. Fruit
- G. Other; specify

IF ONLY ONE IS SELECTED ▶ 18a

RECORD RESPONSE THEN ▶ NEXT TREE

Yes...1
No...2 ▶ NEXT TREE

Shade1
Decoration2
Medicine.....3
Fencing.....4
Firewood.....5
Other; specify.....6

Initial planting1
Pruning.....2
Coppicing.....3
Fertilizer application.....4
Other:.....5

EXAMPLE CODES FOR SECTIONS E, Q1 & Q2

CROPS of TREES ON FARM

Type of Tree	Category	Code
TAMARIND	Fruit Tree	1
CINNAMON	Fruit Tree	2
WALNUT	Fruit Tree	3
RAMBUTAN	Fruit Tree	4
POMME DU SAHEL	Fruit Tree	5
POMELO	Fruit Tree	6
PLUM	Fruit Tree	7
PAW PAW	Fruit Tree	8
ORANGES	Fruit Tree	9
MASAU	Fruit Tree	10
MANGO	Fruit Tree	11
MANDARIN/TANGERINE	Fruit Tree	12
MALAY APPLE	Fruit Tree	13
KOLANUT UNSHELLED	Fruit Tree	14
KOLANUT SHELLED	Fruit Tree	15
KOLANUT	Fruit Tree	16
JACKFRUIT	Fruit Tree	17
GUAVA	Fruit Tree	18
GRAPE FRUIT	Fruit Tree	19
GOD FRUIT	Fruit Tree	20
GISHITA	Fruit Tree	21
DURIAN	Fruit Tree	22
CUSTARD APPLE	Fruit Tree	23
COCONUT	Fruit Tree	24
CHERRY(AGBALUMO)	Fruit Tree	25
BUYA	Fruit Tree	26
BREAD FRUIT	Fruit Tree	27
BILIMBI	Fruit Tree	28
AVOCADO	Fruit Tree	29
APPLE	Fruit Tree	30
AGBONO(ORO SEED)	Fruit Tree	31
STAR FRUIT	Fruit Tree	32
POMEGRANATE	Fruit Tree	33
PEAR	Fruit Tree	34
PEACHES	Fruit Tree	35
LIME	Fruit Tree	36
LEMON	Fruit Tree	37
FIG	Fruit Tree	38
DATE PALM	Fruit Tree	39
BITTER KOLA	Fruit Tree	40

Type of Tree	Category	Code
CHAT	Tree Cash Crops	41
CASTOR BEANS	Tree Cash Crops	42
MORINGA	Tree Cash Crops	43
THREE LEAVE YAM	Tree Cash Crops	44
SHEA NUTS	Tree Cash Crops	45
RUBBER SHEET	Tree Cash Crops	46
RUBBER LUMP	Tree Cash Crops	47
RUBBER	Tree Cash Crops	48
RONIER	Tree Cash Crops	49
PALM KERNEL	Tree Cash Crops	50
OIL PALM	Tree Cash Crops	51
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