Field Test Report on Agri-environmental Indicators (AEIs): towards a Sustainable Agriculture

Publication prepared in the framework of the Global Strategy to improve Agricultural and Rural Statistics

December 2018
Field Test Report on
Agri-environmental Indicators (AEIs):
towards a Sustainable Agriculture
# Table of Contents

Acronyms and Abbreviations ........................................................................................................ 6
Acknowledgements ....................................................................................................................... 7
1. Background of the research .................................................................................................... 8
2. Introduction ............................................................................................................................. 9
3. Objectives ................................................................................................................................... 11
4. Methods and Design .............................................................................................................. 12
   4.1. Questionnaire design.......................................................................................................... 12
   4.2. Enumerator training and feedback ................................................................................... 14
   4.3. Study area and holding selection ..................................................................................... 17
   4.4. Field data collection ......................................................................................................... 19
   4.5. Data analysis .................................................................................................................... 21
5. Results, findings and recommendations ............................................................................... 23
   5.1. Survey implementation and data analysis ....................................................................... 23
   5.1.1. The holding, agricultural activity and agricultural production ................................. 23
   5.1.2. Production practices .................................................................................................... 28
   5.1.3. Other practices ............................................................................................................ 39
   5.1.4. Livestock ...................................................................................................................... 47
   5.2. Lessons learned from the enumerators .......................................................................... 49
6. Conclusions .............................................................................................................................. 51
References ..................................................................................................................................... 53
Annex 1 .......................................................................................................................................... 54
Annex 2 .......................................................................................................................................... 59
Annex 3 .......................................................................................................................................... 70
List of figures and tables

LIST OF FIGURES

Figure 1. Questionnaire designs. Column A: Screenshot of the PAPI version of the questionnaire. Column B: Screenshot of the same section viewed from the CAPI version developed using Survey Solutions.


Figure 3. Pictures depicting fieldwork. A, B, and C: enumerators conducting interviews in the field. D: CATIE vehicle used for transportation.

Figure 4. Distribution of surveyed holdings across seven counties of the Cartago Province. The different colours represent the different holdings’ major agricultural focus (agriculture or livestock). Only 302 of the 307 actual locations from the surveyed holdings could be found from the location data (x,y coordinates) collected by enumerators, because of issues with GPS coverage.

Figure 5. Percentage of holdings, within the Cartago region, reporting livestock (solid area) and crop production (dashed areas) as their main activity.

Figure 6. Different land uses encompassing the total UAA reported, for the corresponding reference period, in selected agricultural holdings from the Cartago Province.

Figure 7. Summary of positive feedback from enumerators during the post-field work follow-up workshop. The numbers correspond to the frequency of responses from enumerators who actively participated in data collection and in the post fieldwork workshop.

Figure 8. Summary of issues requiring revision and improvement grouped into broad categories. Numbers correspond to the frequency of responses from enumerators who actively participated in data collection and in the post-field work workshop.

LIST OF TABLES

Table 1. Original sample distribution provided by INEC by county and district in the Cartago province of Costa Rica.

Table 2. AEIs for the assessment of the relationship between agriculture and the environment.

Table 3. Final distribution of surveyed holdings by country and district in the Cartago province, Costa Rica.

Table 4. AEIs related to soil management, calculated on the basis of information collected through the field test.
Table 5. AEIs related to water use, for irrigation calculated based on information collected during the field test..........................34
Table 6. AEIs related to the use of agrochemicals, calculated on the basis of information collected through the field test. .........................37
Table 7. AEIs at the farm level related to energy use from renewable sources and management of solid waste.................................................40
Table 8. AEIs at the farm level related to management of wastewater. ......43
Table 9. AEIs at the farm level related to water conservation practices. ......45
# Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEI</td>
<td>Agro-Environmental Indicator</td>
</tr>
<tr>
<td>CATIE</td>
<td>Tropical Agricultural Research and Higher Education Center <em>(Centro Agronómico Tropical de Investigación y Enseñanza)</em></td>
</tr>
<tr>
<td>CAPI</td>
<td>Computer-Assisted Personal Interviewing</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>GSARS</td>
<td>Global Strategy to improve Agricultural and Rural Statistics</td>
</tr>
<tr>
<td>ha</td>
<td>hectare</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
</tr>
<tr>
<td>l</td>
<td>litre</td>
</tr>
<tr>
<td>INEC</td>
<td>Institute for National Statistics and Censuses <em>(Instituto Nacional de Estadística y Censos)</em></td>
</tr>
<tr>
<td>IPM</td>
<td>Integrated Pest Management</td>
</tr>
<tr>
<td>PAPI</td>
<td>Paper-and-Pencil Interviewing</td>
</tr>
<tr>
<td>SAC</td>
<td>Scientific Advisory Committee</td>
</tr>
<tr>
<td>SS</td>
<td>Survey Solutions (software)</td>
</tr>
<tr>
<td>UAA</td>
<td>Utilized Agricultural Area</td>
</tr>
</tbody>
</table>
Acknowledgements

The authors would like to thank all of the people and institutions that made the field test possible, in no particular order: the participants in the Expert Group Meeting, held at FAO headquarters, who provided us with important technical advice and suggestions for improvement; the participants in the Scientific Advisory Committee (SAC) of the Global Strategy to improve Agricultural and Rural Statistics (GSARS), who shared useful comments and suggestions for the overall improvement of this research; the Institute for National Statistics and Censuses (Instituto Nacional de Estadística y Censos) of Costa Rica, who provided us with an initial random sample of holdings within the Cartago province; the GSARS Research Coordinators, Flavio Bolliger and Arbab Asfandiyar Khan, and the research focal point, Monica Madrid Arroyo, who provided valuable comments and suggestions for improvement; to the senior advisor for research, Julie Hass, and Cristina Klimzsa, Lorenzo de Simone and Francesco Tubiello, who gave helpful comments and suggestions for improvement; all enumerators who helped to collect thorough and accurate data; CATIE (Centro Agronómico Tropical de Investigación y Enseñanza), for its logistical support to the implementation of this pilot; CATIE’s Biostatistics Unit, particularly Eduardo Corrales, for the critical support given in the development of the survey computer-based (CAPI) version using the Survey Solutions software; and Mayra Alejandra Ospina, who provided critical support on data management and data analysis.
Background of the research

The Global Strategy to improve Agricultural and Rural Statistics (GSARS) is an initiative endorsed by the United Nations Statistical Commission (UNSC) at its Forty-first session in February 2010. GSARS provides an essential framework for meeting the current and emerging data requirements from policy makers and other data users (World Bank, UN and FAO, 2011). The GSARS research component was set up in response to country requests and is based on an assessment of data users’ needs. These assessments have led to the formulation of a conceptual framework that relates the economic, social, and environmental dimensions of agriculture to one another. The development of agri-environmental indicators (AEIs), as well as operational guidelines for data collection and processing into statistics and indicators, were needs expressed by countries, and were thus included in the 2016 GSARS annual plan. This was particularly important as many countries, especially in the developing world, lack the capacity to produce and report even the minimum set of agricultural statistics required to monitor national trends.

Sustainability has become one of the main points of reference for international and national development goals, regarding which it is essential to develop methods and procedures to measure and monitor agricultural sustainability. For this reason, the research thematic domain entitled SUST – Data collection methods on sustainable agriculture – was included in the GSARS Research Component domains. The objective of SUST is to provide a framework for agricultural sustainability indicators and related statistical definitions, as well as measurement tools covering the economic, social and environmental dimensions. Furthermore, to develop guidelines on best practices, it is necessary to establish efficient and cost-effective methodologies are needed that the countries can use to generate, in particular, agri-environmental statistics and indicators. Specifically, the third SUST research topic, SUST-3: Data collection methods for agri-environmental indicators, seeks to develop a concise set of indicators that can be used to monitor whether agricultural practices are producing an impact on the environment and are moving towards the implementation of a more sustainable agriculture. In particular, these indicators seek to describe the biophysical condition or health of components such as soil, water, land cover and land use, as well as biodiversity, all critical elements affecting food production systems.
Introduction

Methods to collect appropriate information enabling the construction of AEIs is lacking in the majority of countries around the world. This technical report presents the results of a field test implemented in Costa Rica as part of the research activities planned within the frame of GSARS research line “SUST-3: Data collection methods for agri-environmental indicators”. The main objective of the field test was to analyse whether the agri-environmental module proposed included the accurate variables required to construct the core set of AEIs prioritized as those suitable for measuring whether the agricultural practices implemented for crop and livestock production are moving towards sustainable agriculture. These practices play a major role in shaping the type and magnitude of the pressures and impact that agriculture has on the environment, and its assessment is urgent if actions towards more sustainable food production worldwide are to be designed and implemented.

The survey module was designed to be applied either as a stand-alone survey or as a part of established national agricultural surveys. The inclusion of this module within national agricultural surveys will support the development of a standardized statistical methodology that can monitor whether agricultural practices are producing negative pressures on the environment or whether they are contributing towards a more sustainable agricultural production.

Moreover, the field test sought to assess the survey instrument, by identifying potential problems for both respondents and enumerators with regard, for example, to the wording of questions and skip patterns, and to evaluate alternative ways of measuring variables of interest and conducting the interviews. By implementing the module among agricultural holdings located in the Cartago province of Costa Rica, this work also allowed for evaluation of the enumerator’s manual, mainly considering its usefulness for enumerators as a tool to help clarify doubts or questions expressed by respondents during survey application, and as guidance material to help enumerators record information in the appropriate manner.

The present document discusses the steps taken in designing the data collection instruments and the methods for the implementation of this agri-environmental module, as well as the main results of a field test carried out during February–March 2018 in Costa Rica. In addition to the information covered in sections 1
(Background of the research) and 2 (Introduction), the document also covers the following: 3 – Objectives; 4 – Methods and design; 5 – Results, findings and recommendations; and 6 – Conclusions. Additionally, the annexes section includes (1) complementary results (annex 1), (2) the Paper-and-Pencil Interviewing (PAPI) version of the module (annex 2) and (3) the accompanying enumerator’s manual for conducting interviews (annex 3).
Objectives

General
Evaluate the appropriateness of the agri-environmental module as a data-collecting instrument for capturing accurate information that can enable the construction of AEIs related to the impact of agricultural practices on the environment.

Specific
Test the module of AEIs designed and evaluate:

(1) appropriateness of language and terminology used throughout the survey;
(2) flow of questions proposed in the questionnaire;
(3) if the survey should be applied at plot, farm, or household level;
(4) feasibility of obtaining information related to specific agricultural practices and within the proposed reference period;
(5) overall length of the survey and estimated time required to conduct a complete interview;
(6) the profile of enumerators and supervisors required in this type of research;
(7) holder’s response and need to adapt or change survey format;
(8) instructions for enumerators included in the enumerator’s manual;
(9) methods to analyse, process and present the data collected;
(10) methods to calculate the core set of indicators.
Methods and Design

4.1. Questionnaire design

As part of the construction of appropriate data collection tools, a paper-based version (Paper and Pencil Interviewing, PAPI) of the questionnaire was designed. The PAPI version of the questionnaire enabled clear statement of the desired order of the sections and questions included therein, as well as the creation of a short and readable questionnaire to maximize its applicability on the field.

Once the appropriate order of sections and questions was established, the work began on the design and construction of a computer-based version (Computer-Assisted Personal Interviewing – CAPI) using the Survey Solutions Designer software.1 This free-access online software enables the creation of questionnaires with a wide variety of options for section and question construction. For example, Survey Solutions allows for the inclusion of (1) filter yes-or-no questions (such as use or non-use of a specific agricultural practice); (2) multiple-option questions (both exclusive and non-exclusive, such as a selection of reasons for the implementation of certain agricultural practices, or a selection of specific waste treatments); and (3) open questions (address, name, etc.).

The CAPI version mostly followed the structure of the PAPI version. However, when required, and for the purpose of creating a more accessible tool for enumerators and respondents, filter questions were added as required and sections or subsections were arranged in a different order (figure 1). Moreover, the software allows for the inclusion of detailed instructions for enumerators, which constitute valuable guiding tools when conducting interviews. The flexibility of the computer-based version is an important advantage that designers must take into account.

1 http://support.mysurvey.solutions/
Figure 1. Questionnaire designs. Column A: Screenshot of the PAPI version of the questionnaire. Column B: Screenshot of the same section viewed from the CAPI version developed using Survey Solutions.

### A. 1 THE HOLDING 1.1 SURVEY PREPARATION

<table>
<thead>
<tr>
<th>Column A: Screenshot of the PAPI version of the questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire Setup</td>
</tr>
<tr>
<td>Enumerator first name:</td>
</tr>
<tr>
<td>Enumerator surname:</td>
</tr>
<tr>
<td>Start time:</td>
</tr>
<tr>
<td>Date:</td>
</tr>
</tbody>
</table>

**Questions 1 and 2 will be answered by the enumerator**

1. Was the holding provided to the enumerator found?
   - 1 No → End the survey
   - 2 Yes → Go to Q3

2. Was someone from the holding found who accepted responding to the survey?
   - 1 No → End the survey
   - 2 Yes → Go to Q3

3. Did the holding grow any crops, or raise animals during the reference period?
   - 1 No → End the survey
   - 2 Yes → Introduce the survey using the text in the enumerator manual and continue the survey

4. Do you have enough information to answer questions related to agricultural practices in the holding? (If required give the respondent more details about the subjects and questions included in the survey)
   - 1 No → End the survey
   - 2 Yes → Go to Q3

5. Record the following information about the respondent:

   a. Function on the agricultural holding (Select one option only)
      - 1 Holder (legal and/or economically responsible for the holding)
      - 2 Co-holder (legal and/or economically co-responsible for the holding)
      - 3 Manager (responsible for the day-to-day decisions on the farming operations)
      - 4 Employee or household member working on the holding
      - 5 Household member not working on the holding
      - 6 Other (Specify:___________)

   b. First name:___________
   c. Surname:___________

   d. Sex
      - 1 Male
      - 2 Female

   e. Address: Street________________________ Village, town________________________
      County________________________ Province________________________

   f. Cell phone:______________
   g. Home phone:______________
   h. e-mail:__________________

### B. Screenshot of the CAPI version developed using Survey Solutions
4.2. Enumerator training and feedback

A training workshop was conducted on 12 February 2018 in the CATIE headquarters. A total of 17 enumerators, with different backgrounds and nationalities, were preselected to participate in this training workshop (figure 2). The preselected enumerators comprised a diversity of professional capacities and knowledge about agricultural practices and natural resources, with backgrounds ranging from undergraduate agronomy students to master-level students in the field of natural resources (conservation, management, etc.), representing six Latin American countries (Costa Rica, Nicaragua, Mexico, Peru, Ecuador and Colombia). The diversity of the preselected enumerators allowed for simultaneous testing of the language and terminology used on both the survey instrument and the enumerator’s manual. Prior to the training workshop, all participants were provided with the latest version of the survey instrument and enumerator manual, which included improvements from lessons learned from a pre-test\(^2\) conducted within the Turrialba County of Cartago, as well as recommendations for changes provided by the GSARS team and a senior consultant.

The topics addressed during the training workshop included: (i) the main goals of the GSARS project; (ii) the main goals of the agri-environmental module to evaluate the process of data collection and analysis towards the construction of a set of AEIs related to the impact of agricultural practices on the environment; (iii) background information on the impact of agriculture on natural resources; (iv) the main goals of the field test; (v) survey structure, including a detailed revision of the content and skipping patterns; (vi) similarities and differences between the PAPI and CAPI version of the survey; (vii) functioning and appropriate use of the equipment (Android tablets and the Survey Solutions app) for data collection using the CAPI version; and (viii) the selection of appropriate respondents and general aspects to consider and techniques to appropriately conduct an interview (issues to avoid to obtain unbiased responses, respectful demeanor, etc.).

The training workshop focused on giving a detailed explanation of the CAPI version of the survey and the accompanying enumerator’s manual. This detailed revision was essential to familiarize all preselected enumerators with the type of data to be collected and for them to understand the importance of accurately

---

\(^2\) To assess the overall performance of the survey, a pre-test was conducted on agricultural holdings located in the Turrialba region, from 23 to 29 January. A total of 14 interviews were performed in both large and small holdings, with holding sizes ranging from 1 to 475 ha.
collecting this information. A detailed explanation of each survey section – as well as an explanation of the questions’ objectives, instructions on how to formulate questions, methods needed to calculate agrochemical use per agricultural area, and skipping patterns – were provided. The training on the use of the Survey Solutions software (data collection app) and the use of the tablet itself were particularly important.

From the total participants to the training workshop, 12 were selected on the basis of their understanding of the necessary tools and time availability to conduct fieldwork. Four enumerators were undergraduate students in their last year of agricultural sciences. The remaining enumerators corresponded to CATIE’s graduate students, enrolled in the first or second year of their programs, focusing on different areas related to natural resources (conservation and management of biodiversity, agroforestry systems or rural development). Selected enumerators were asked to take notes on the issues and areas of improvement detected while conducting interviews (regarding both the survey and the enumerator’s manual), to allow for improvement of the tools following the field test. Particularly, enumerators were asked to annotate all relevant information, focusing on the following questions:

i) Do you consider that the questions and overall terminology are well understood by respondents?

ii) Do the response categories of the survey reflect country-specific situations (local units of measurement, problems associated with soil fertility, etc.)?

iii) Do you consider the translations from English to Spanish to be accurate?

iv) Do you think that the equipment (Android tablets) and software (Survey Solutions) are suitable for the collection of reliable data?

v) Are there any missing components that should be added to the survey, or redundant sections that should be removed?

vi) Do you consider skip patterns to be consistent with the flow of questions?

vii) How long does it take to conduct a complete interview, and how many holdings can an enumerator reasonably visit per day?

Once the fieldwork was completed, a follow-up workshop was conducted with enumerators to receive their feedback on the abovementioned questions. The follow-up workshop focused on learning from enumerators on the issues and improvement opportunities identified while conducting interviews. Enumerators were asked to share notes and to provide a general opinion on overall survey implementation, in particular on the following: (i) fieldwork logistics (transportation, schedules, areas visited, etc.); (ii) use of Android tablets; (iii) use of the Survey Solutions app; (iv) overall survey structure (language, length of survey, etc.); and (v) the overall structure of the enumerator’s manual (that is, the usefulness of the information as well as the straightforwardness of the definitions and explanations included therein). The results of this follow-up workshop are presented in section 3.3.
4.3. Study area and holding selection

The general objective of the field test was not to obtain statistically representative data at national or subnational level, but rather to evaluate the appropriateness of the agri-environmental module as a data-collecting instrument for capturing accurate information that can enable the construction of AEIs related to the impact of agricultural practices on the environment. Taking this into consideration, Costa Rica’s Cartago province (see figure 4) was selected as the testing sampling area.

Cartago is the third-most populated province of Costa Rica (INEC, 2012) and the fifth province with the largest area dedicated to agricultural production (92 799.2 ha and a total of 9 558 farms; INEC, 2015), dominated by small farms having an average size of 9.7 ha. Additionally, at the national level, Turrialba county is the third county in terms of the number of agricultural farms, representing a total area of 49 483 ha. Cartago province was selected as it is representative of a wide variety of agricultural practices and production systems. Of all farms included in the National Agricultural Census, 16.8 percent are dedicated to bovine livestock, 26.4 percent to coffee, 14 percent to fruits, 3.7 percent to basic grains, 25 percent to vegetables and 14.1 percent to other agricultural or tourism activities (INEC, 2015).

The Costa Rican Institute for National Statistics and Censuses (or Instituto Nacional de Estadística y Censo – INEC) collaborated with this research by providing an initial random sample selection of 400 agricultural holdings, distributed across all counties of Cartago province. The use of the random sample method enabled identification of a wide variety of farms and production types (that is, of the crops reported to be grown in each farm), allowing for the random selection of a representative sample of all types of farms and crops present within Cartago province. The overall goal of the field test was to conduct 300 interviews; however, anticipating issues involving the holdings’ locations (locating the holding itself with the information provided, the distance between holdings, etc.), a larger sample was requested (in particular, an additional 33 percent of the original target of 300). Information from this initial random sample was derived from the 2014 National Agricultural Census (table 1).

The information provided always included the holding’s physical address and, in some cases, the approximate $x,y$ coordinates. In other cases, if privacy restrictions allowed (that is, the respondents to the agricultural census did not specifically ask such information to be withheld), the holder’s name, telephone number or home address were also included; however, this did not constitute the norm. Restrictions on the information regarding the holding and holder
information applied to most of the sample; added to the fact that in Costa Rica, postal addresses are rarely used, if at all (for example, directions include simple descriptors such as “from the greenhouse 100 m after the bus stop”), made it difficult to locate the holdings.

The difficulties encountered in finding holdings based solely on the description of the physical addresses provided made it necessary to adjust the initial methods proposed for holding identification. As a result, the instructions provided to the enumerators for finding the holdings included a two-step process, in which enumerators would first allocate time to search for the holdings provided by the INEC sample. If the enumerators were unable to locate those holdings using all available information, they were then instructed to conduct farm searches utilizing the snowball sampling method,³ also known as chain-referral sampling. The reasons noted for being unable to locate holdings included: (1) if $x,y$ coordinates were provided, these did not match the terrain; (2) $x,y$ coordinates were not provided; or (3) the physical addresses were not accurate (that is, not even close neighbors recognized the names of the holding or holder). The adapted two-step protocol was applied across all sampled areas within Cartago province.

³ The snowball sampling is a non-probabilistic method that consists in requesting each interviewed farmer to provide information on another potential farmer to interview; the location of the latter may be near or far (Nusser and House, 2011).
# Table 1. Original sample distribution provided by INEC by county and district in the Cartago province of Costa Rica.

<table>
<thead>
<tr>
<th>County</th>
<th>District</th>
<th># of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartago</td>
<td>Aguacaliente o San Francisco</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Carmen</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Corralillo</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Dulce Nombre</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Guadalupe o Arenilla</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Llano Grande</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Occidental</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Quebradilla</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>San Nicolás</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Tierra Blanca</td>
<td>27</td>
</tr>
<tr>
<td>Paraiso</td>
<td>Cachi</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Orosi</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Paraiso</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Santiago</td>
<td>41</td>
</tr>
<tr>
<td>Turrialba</td>
<td>La Isabel</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>La Suiza</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Pavones</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Peralta</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Santa Cruz</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Santa Rosa</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Santa Teresita</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Tayutic</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Tres Equis</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Tuis</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Turrialba</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>400</td>
</tr>
</tbody>
</table>

## 4.4. Field data collection

The field test was conducted between 21 February and 5 March (13 days of fieldwork). A total of 12 enumerators and 4 supervisors participated during the different days conducting fieldwork. During each field visit, a total of 12 enumerators and at least 2 supervisors visited selected districts (figure 4). The enumerators were divided into two teams and each team was led by one supervisor. Both teams were deployed in two distinct areas within the same district. The supervisors were in charge of transporting enumerators to different holdings, especially if the holdings were far apart from one another; supervisors remained in the area to oversee the work of enumerators, while conducting interviews or facilitating transportation for the enumerators who were seeking to
locate specific holdings. The supervisors alternated their presence in the field and, if necessary, were also deployed to conduct interviews.

Given the overall length of the survey and the time needed to locate specific holdings, a minimum of three interviews were identified as feasible for each enumerator to conduct during a complete fieldwork day. The enumerators were each provided with the following: (1) an Android tablet on which the Survey Solutions software had been installed and tested, which constituted the primary tool for data collection; (2) a digital map depicting the location \((x,y)\) coordinates of potential holdings based on INEC data; (3) materials required to take field notes (notebook, pencil, etc.); (4) a printed copy of the enumerator’s manual; and (5) several copies of the PAPI version in case of tablet malfunction.

The enumerators visited different holdings within the selected survey areas to localize farmers who were willing to participate in the study. Meetings between the enumerators and supervisors were held at the end of each day to discuss the general development of the fieldwork and address specific questions.

**Figure 3. Pictures depicting fieldwork. A, B, and C: enumerators conducting interviews in the field. D: CATIE vehicle used for transportation.**
4.5. Data analysis

The data processing and feedback received in the follow-up workshop (section 5.2) enabled the performance of a qualitative analysis that highlighted issues and provided recommendations for improvements regarding survey structure and content (question sequence, reference period, respondents’ unique interpretation of specific questions, etc.), as well as the structure and content of the enumerator’s manual.

Moreover, a quantitative analysis of the collected variables was conducted to assess their reliability in calculating the 18 proposed AEIs (table 2). Quantitative analyses were performed using the InfoStat software (DiRienzo et al., 2018).
Table 2. AEIs for the assessment of the relationship between agriculture and the environment.

<table>
<thead>
<tr>
<th>Theme domain</th>
<th>Subdomain</th>
<th>Indicator</th>
<th>Description</th>
<th>Unit of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>management 1. Soil health</td>
<td>1.1. Tillage practices</td>
<td>Share of total Utilized Agricultural Area (UAA) under conventional, conservation and zero tillage</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.2. Use of protective soil cover</td>
<td>Share of the year and area of total UAA that is covered by plants or plant residues</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.3. Use of agricultural burning</td>
<td>Share of total UAA subjected to burning practices</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.4. Soil erosion mitigation practices</td>
<td>Share of total UAA under soil erosion mitigation practices</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5. Crop rotation patterns</td>
<td>Share of total UAA under a crop rotation scheme</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.6 Rotational grazing patterns</td>
<td>Share of total UAA under rotational grazing</td>
<td>%</td>
</tr>
<tr>
<td>Water</td>
<td>management 2. Use of freshwater resources</td>
<td>2.1. Fully controlled irrigation</td>
<td>Share of irrigable and irrigated area of total UAA</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.2. Water conservation practices</td>
<td>Use of water conservation practices</td>
<td>Categories</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.3 Livestock watering practices</td>
<td>Use of different water sources</td>
<td>Categories</td>
</tr>
<tr>
<td>Nutrient and</td>
<td>pesticide management 3. Agrochemical use</td>
<td>3.1. Chemical fertilizer use</td>
<td>Amount of chemical fertilizers (N, P, K) used per area of total UAA</td>
<td>kg/ha</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.2. Pesticide use</td>
<td>Amount of pesticides used per UAA</td>
<td>kg/ha</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.3. Integrated Pest Management (IPM) practices</td>
<td>Share of total UAA under IPM</td>
<td>%</td>
</tr>
<tr>
<td>Land use and</td>
<td>land cover management 4. Changes in land cover</td>
<td>4.1. Cropping patterns</td>
<td>Share of total UAA corresponding to temporary and permanent crops; and temporary and permanent grasslands</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.2. Landscape habitat elements</td>
<td>Presence in the farm of the following landscape elements: hedges, live fences, dispersed trees, shade trees, forest plantations, home gardens, secondary forest patches, mature forest patches, riparian forests, and windbreaks</td>
<td>Presence or absence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.3. Farm landscape diversity</td>
<td>Landscape diversity calculated from all land cover types (including different agricultural land and landscape habitat elements) present at the farm</td>
<td>Unitless</td>
</tr>
<tr>
<td>Energy use</td>
<td>5. Renewable energy use</td>
<td>5.1 Energy use from renewable sources</td>
<td>Use of energy from renewable sources</td>
<td>Categories</td>
</tr>
<tr>
<td>Waste</td>
<td>management 6. Management of waste</td>
<td>6.1. Management of solid waste</td>
<td>Management of solid waste from crop production, including plastic, agrochemical and waste from machinery</td>
<td>Unitless</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.2. Management of wastewater</td>
<td>Management of wastewater derived from domestic and agricultural activities</td>
<td>Unitless</td>
</tr>
</tbody>
</table>
Results, findings and recommendations

5.1. Survey implementation and data analysis

The proposed module for the construction of AEIs comprised five different sections: (1) The holding; (2) Agricultural production; (3) Production practices; (4) Other practices; and (5) Livestock production.

The main results, including the calculation of indicators, issues encountered during implementation and data analysis, as well as recommendations or changes and additional comments to both the survey and the enumerator’s manual are described following the structure of the PAPI version of the survey (annex 2), and are presented as follows.

Results related to a percentage of the holdings, a percentage of the Utilized Agricultural Area (or UAA; that is, the UAA corresponding to permanent and temporal crops and grasslands, and temporary fallow), and the percentage of practices implemented by land use type must be interpreted considering the corresponding reference period, established as the last 12 months prior to the interview. All of the data collected and presented here should be interpreted in the context of the reference period; that is, the information presented here is not a reflection of the farm state on the day of the interview, but rather a recollection of information about the agricultural practices conducted across the reference period.

5.1.1. The holding, agricultural activity and agricultural production

These sections aim to collect general information about the respondent, the holding and the agricultural production conducted on the holding.

⇒ Results

A total of 7 counties and 26 districts were surveyed, for a total of 307 interviews conducted (table 3, figure 4), which met the goal set for this field test exercise. Only one holding was located outside the Cartago Province, immediately beyond the border with the San José County, belonging to the San José Province.
Table 3. Final distribution of surveyed holdings by country and district in the Cartago province, Costa Rica.

<table>
<thead>
<tr>
<th>County</th>
<th>District</th>
<th># of surveys</th>
<th>County</th>
<th>District</th>
<th># of surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alvarado</td>
<td>Cervantes</td>
<td>6</td>
<td>La Suiza</td>
<td>Pavones</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Pacayas</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cartago</td>
<td>Corralillo</td>
<td>15</td>
<td>Peralta</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Llano grande</td>
<td>4</td>
<td>Santa Cruz</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Quebradilla</td>
<td>2</td>
<td>Santa Teresita</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Tierra blanca</td>
<td>1</td>
<td>Tayutic</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>El Guarco</td>
<td>Patio de agua</td>
<td>2</td>
<td>Tres equis</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Tobosí</td>
<td>12</td>
<td>Tuis</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Jiménez</td>
<td>Pejibaye</td>
<td>16</td>
<td>Turrialba</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Tucurrique</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>302**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oreamuno</td>
<td>Cipreses</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cot</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potrero cerrado</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paraiso</td>
<td>Cachí</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orosi</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paraiso</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Santiago</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Only 302 of the 307 actual locations from the surveyed holdings could be found from the location data (x,y coordinates) collected by the enumerators, because of issues with GPS coverage.
Figure 4. Distribution of surveyed holdings across seven counties of the Cartago Province. The different colours represent the different holdings’ major agricultural focus (agriculture or livestock). Only 302 of the 307 actual locations from the surveyed holdings could be found from the location data ($x$, $y$ coordinates) collected by enumerators, because of issues with GPS coverage.

An average of 34 interviews were conducted per day (three to four interviews per enumerator). The average time required to complete an interview was 45 minutes; the shortest interview lasted 12 minutes and the longest lasted 3 hours. The most important variables determining length of survey application was not the size of the holding, but rather the number of crops cultivated, and the amount of inputs used (for example, whether agrochemicals were applied).

Most respondents corresponded to holders or co-holders living on the holding (79 percent), followed by holding managers responsible for the day-to-day decisions on the holding operations (13 percent). The remaining 8 percent corresponded to respondents identified as employees. The majority of the respondents had good knowledge of management practices and technical language. The majority of the respondents were men (84.7 percent).

The selected holdings included a variety of holding sizes, ranging from 0.05 ha to 230 ha, with an average holding size of 9 ha. Most holdings reported crop production as the main agricultural focus (69 percent), while the remaining 31 percent reported livestock production as their main activity. The main cropping activity varied among respondents; however, the majority of the holdings...
focusing on crop production reported production of perennial crops (such as coffee, cacao, plantain – 42.5 percent) and vegetables (peppers, lettuce, cabbage, green beans, etc. – 32.5 percent) (figure 5). Annual crops (maize, beans, potatoes, etc. – 20.8 percent) and fruits (tangerines, Costa Rican guavas, also known in Spanish as cas, palm fruit, etc. – 4.2 percent) production were less reported (see figure 5). Most of the holdings reporting livestock production as their main agricultural activity corresponded to big cattle for milk production.

**Figure 5. Percentage of holdings, within the Cartago region, reporting livestock (solid area) and crop production (dashed areas) as their main activity.**

Regarding land use within holdings, all holdings reported an average UAA\(^4\) of 7.5 ha. Of all holdings, 41 percent reported having land dedicated to farm buildings and farmyards of an average of 0.24 ha, and 22.8 percent reported having forests with an average area of 3.34 ha. Moreover, 11.4 percent of holders reported performing agricultural activities in land outside their farm, on owned, rented, borrowed or communal land with an average size of 6.7 ha (specifically, ranging between 0.01 ha to 116.02 ha).

A total UAA of 2,297.25 ha were reported by the 307 holdings surveyed, including land outside the holder’s farms. Overall, within the holdings surveyed, the majority of the UAA corresponded to permanent grasslands (62.07 percent), followed by permanent crops (20.89 percent), temporary crops (16.74 percent),

---

\(^4\)UAA, or Utilized Agricultural Area, includes area dedicated to temporary and permanent crops and grasslands, and temporary fallow.
temporary fallows (0.28 percent) and temporary grasslands (0.02 percent) (figure 6); this information constitutes the indicator cropping patterns (table 2).

![Figure 6. Different land uses encompassing the total UAA reported, for the corresponding reference period, in selected agricultural holdings from the Cartago Province.](image)

－ Issues, comments and recommendations

- It is recommended to ask the farmer’s age and education level when the farmer is acting as the respondent, as the implementation of certain agricultural practices may be associated with age or education level.
- It is recommended to plan the fieldwork for the survey considering the farmers’ daily and weekly schedules. These will vary across countries and regions. In Costa Rica, farmers do not work in the field during the weekends, because they are either transporting or directly selling their products in farmer markets. On a daily schedule, it is important to consider that some crops do not require daily attention (such as cabbage and potatoes), or that fieldwork for the survey is usually only conducted in the morning.
- It is recommended that the response categories of the main agricultural focus and activities be changed to reflect every country situation. This recommendation should be applied to the whole survey, in particular to adapt to country-specific terminology and language.
● Enumerators must check that the sum of the area of the different land uses in question 15 (Q15,\(^5\) annex 2) must be the same (or at least approximately the same) as, but not larger than, the total area of the holding provided in Q14.\(^6\)

● Before asking Q15 and Q16,\(^7\) it is recommended that the enumerator ask respondents to describe the holding, the crops being cultivated, the areas used for pastures, and other land uses (buildings, etc.), and, if possible or appropriate, ask respondents to draw a sketch of the holding. This will greatly help the enumerators to understand the number of plots used and the distribution of crops and pastures within the holding.

5.1.2. Production practices

This section aims to collect specific information about the agricultural practices implemented on the holding and is divided into four subsections: soil management, irrigation, fertilizers, and pesticides. For purposes of presentation and clarity of results, the section corresponding to fertilizers and pesticides is presented together.

In general, in this section, respondents answered specific questions related to proportions and technical concepts, for example including proportions of plot under certain practices, and agrochemical names and toxicity levels (indicating label colours). In particular, smallholders were aware of the quantities of fertilizers and pesticides applied to their crops; however, enumerators encountered difficulties in translating these numbers into quantities per ha (amounts per area). More detailed explanations of the issues encountered are provided below.

Soil management

⇒ Results

The following are the main results related to practices of soil management, including the report on the selected AEIs (table 2). Additional results, related to the number of holdings implementing specific practices by categories of holding size, are presented in annex2.

\(^5\) Q15. Please indicate the area of the holding used for agricultural production and other land purposes.
\(^6\) Q14. What is the total holding area?
\(^7\) Q16. Did you perform agricultural activities in land outside the farm (owned, rented, borrowed or communal land)?
Tillage practices

- Of the 307 holdings surveyed, 45.9 percent reported using tillage practices. Farmers reported using more than one tillage type depending on the number and type of crops cultivated. Of the holdings where tillage was implemented, 62.4 percent implemented conventional tillage and 37.6 percent conservation tillage.

- Tillage categories are not mutually exclusive and more than one tillage practice can be implemented by a single holding, depending on the type of crops being cultivated. In 79.7 percent of the total UAA, tillage was not implemented. The indicator “share of total utilized agricultural area under different tillage practices” was of 16.5 percent for conventional tillage and 3.9 percent for conservation tillage (table 4). The share of total UAA for any type of tillage was 10.13 percent.

- Although almost 50 percent of holdings reported using at least one category of tillage practices, conventional tillage was implemented in only 16.5 percent of the total UAA, with conservation or no tillage being implemented in a greater share of the total UAA in which. Conservation tillage includes all tillage practices not involving soil inversion. A greater share of UAA under the conservation or zero tillage categories is desirable, being a positive indication of moving towards a more sustainable agricultural production.

- Of the total UAA in which conventional tillage practices were implemented, 78.5 percent corresponded to temporary crops, and only 16.8 percent and 4.7 percent corresponded to permanent crops and permanent grasslands respectively.

- Conservation tillage was mostly and equally implemented in permanent and temporary crops, and often involved simple soil movement (that is, not involving soil inversion) with hand tools (table 4).

Use of protective soil cover

- Of the 307 holdings surveyed, 14.1 percent reported using some form of protective soil cover. Protective soil cover categories are not mutually exclusive and more than one protective soil cover type can be implemented in a single holding.

- Of the holdings implementing protective soil cover, 69.41 percent, 35.3 percent and 14.1 percent respectively used plant residues, weeds and cover crops as protective soil cover.

- The indicator “share of total utilized agricultural area under protective soil cover” indicated that 81.8 percent of the total UAA was not covered and 18.2 percent was covered, with 11.6 percent covered with plant
residues, 3.3 percent covered with crops, and 3.3 percent covered with weeds (table 4).

- The average time of permanence of plant residues, weeds and cover crops was respectively 146.2, 127.3, and 267.0 days per year.
- The indicator “share of the year that total utilized agricultural area is covered” was of 73.2 percent for crop cover, 40.1 percent for plant residues, and 34.9 percent for weeds (table 4). The share of total UAA for any type of soil cover was 18.16 percent.
- Results showing a greater share of areas in which no protective soil cover is implemented (that is, bare soil) constitutes an indication of actions having a potentially negative impact on soil health that may compromise food production sustainability, particularly through negative effects derived from soil erosion and nutrient loss.
- Moreover, when data is analysed by land use type, of the 11.7 percent of UAA area where plant residues are utilized as protective soil cover, 68.8 percent corresponded to permanent crops, 27.9 percent to permanent grasslands and 3.3 percent to temporary crops. Usually, in these cases, plant residues correspond to vegetal material left on the ground after a pruning or cleaning process. Weeds, when utilized, were mostly reported in areas with temporary crops, and according to its definition, most of the agricultural area where protective soil cover was not used (81.8 percent), 69.4 percent corresponded to permanent grasslands (table 4).

Burning practices

- 4.1 percent of the total holdings reported the use of agricultural burning. The more frequent reason for implementing this practice was the reduction of unwanted plant species (91.7 percent), followed by reduction of crop residues (33.3 percent) and control of pests/diseases (25 percent). The reasons for implementing burning categories are not mutually exclusive and the respondent could choose more than one reason. Therefore, the percentages presented here do not add up to 100 percent.
- The indicator “share of total UAA subjected to burning practices” was 1.1 percent (table 4). A lower share of total UAA subjected to agricultural burning is a desirable and positive indication of moving towards a more sustainable agricultural production, helping to maintain the soil’s physical and chemical properties.

Soil erosion control (SEC) practices

- SEC practices were implemented in 46.8 percent of the holdings. Most of the holdings (58.3 percent) that reported using some kind of SEC practice utilized vegetative practices (reforestation, contour hedgerows,
natural vegetation strips and live fences), 48.7 percent reported using structural practices (constructing physical structures such as terraces, diversions and drop structures), 31.4 percent management practices (land use change, area closures, etc.), and 21.9 percent agronomic practices (intercropping, contour cultivation, minimum tillage and mulching). SEC practices over categories are not mutually exclusive and more than one practice can be implemented in a single holding.

- Although almost 50 percent of holdings reported implementing SEC practices, the indicator “share of total utilized agricultural area under soil erosion mitigation practices” was equal to 28.9 percent (table 4).
- A small share of total UAA under soil erosion mitigation practices might be an indication of poorly care for soils; however, this must be analysed in light of the specific context of holdings’ locations (that is, flat areas versus steep areas).
- Furthermore, of the total UAA in which soil erosion mitigation practices were implemented, 38.7 percent and 36.1 percent respectively corresponded to permanent crops or permanent grasslands, only 24.9 percent to temporary crops and 0.3 percent to temporary fallow, indicating that fewer SEC practices are implemented in areas designated for these types of land use (table 4).

Crop rotation

- Crop rotation was implemented in 23.7 percent of the surveyed holdings.
- Most of the area in which crop rotation occurs involves the rotation of three (48.7 percent of total area) or two (32.9 percent of total area) crop types.
- The indicator ‘share of total utilized agricultural area under a crop rotation scheme’ was for a total of 10.5 percent.
- According to the definition of the different land use types, the vast majority of rotation was implemented in temporary crops, that is, in 98.77 percent of the UAA (table 4).
- As for the general soil problems encountered by farmers, 41.4 percent of respondents indicate noticing loss of soil by water erosion or wind erosion in their farms; 51.5 percent noticed a reduction in the fertility of their soil affecting production, and 24.8 percent noticed an excessive accumulation of water on part of their holding, affecting production.
- 59.1 percent of holdings reported not having soil problems. Of the holdings that did report these issues, 27.2 percent reported that it affected less than 50 percent of their properties, 11.4 percent reported these issues affected more than 50 percent of their properties and 2.3 percent reported that they once had to address these issues but the situation has now improved.
Table 4. AEIs related to soil management, calculated on the basis of information collected through the field test.

<table>
<thead>
<tr>
<th>Tillage practices</th>
<th>Share of utilized agricultural area (%)</th>
<th>Protective soil cover</th>
<th>Tillage practices</th>
<th>Share of utilized agricultural area (%)</th>
<th>Protective soil cover</th>
<th>Tillage practices</th>
<th>Share of utilized agricultural area (%)</th>
<th>Protective soil cover</th>
<th>Tillage practices</th>
<th>Share of utilized agricultural area (%)</th>
<th>Protective soil cover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percental **</td>
<td></td>
<td></td>
<td>Percental **</td>
<td></td>
<td></td>
<td>Percental **</td>
<td></td>
<td></td>
<td>Percental **</td>
<td></td>
</tr>
<tr>
<td>Conventional</td>
<td>18.10</td>
<td>16.60</td>
<td>16.50</td>
<td>3.90</td>
<td>79.70</td>
<td>18.20</td>
<td>3.30</td>
<td>81.80</td>
<td>73.20</td>
<td>40.10</td>
<td>34.90</td>
</tr>
<tr>
<td>No-tillage</td>
<td>22.10</td>
<td>16.80</td>
<td>25.40</td>
<td>3.00</td>
<td>78.90</td>
<td>22.50</td>
<td>3.60</td>
<td>76.20</td>
<td>66.90</td>
<td>45.60</td>
<td>32.40</td>
</tr>
<tr>
<td>Temporary</td>
<td>73.84</td>
<td>78.50</td>
<td>54.10</td>
<td>5.10</td>
<td>20.95</td>
<td>24.30</td>
<td>3.30</td>
<td>73.80</td>
<td>17.60</td>
<td>30.36</td>
<td>17.50</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.00</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* Values are calculated over the % of area were the practices is implemented. **PR: Plant Residues. ***Indicator share of the year where soils are protected is a weighted value per area. In this sense greater areas have higher weight in the estimation of number of days of the cover crop. Values of share of the year are given for specific combination of land use and soil cover type, and columns should not sum 100%. N/A indicates that specific practices were not reported in a certain land use category.

All indicators here presented correspond to the share of total UAA (2,297.25 ha) where the implementation of different agricultural practices was reported. With reference to the first row, it should be noted that tillage categories are not mutually exclusive and thus their sum will not be equal to 100 percent (first row). Information included in subsequent rows corresponds to the percentage of the UAA dedicated to specific land uses (permanent crop, temporary crops, etc.) in which the practices were implemented. The sum of percentages of each practice per land use is equal to 100 percent.

**Issues, comments and recommendations**

- Enumerators encountered problems in differentiating between different types of tillage practices. It is recommended to ensure that enumerators are well-trained on this matter, and to provide them with an image or photographic guide, with examples of different tillage practices adjusted to the specifics of the countries of implementation.
- There was confusion resulting from the use of the word *quema* (burning). Costa Rica, the term can also mean the use of herbicides, *queumante*. Although this issue is context-specific, it draws attention to the need to adapt questions and terminology to the specifics of the countries of implementation, and the use of pictures to clearly explain what agricultural burning means in this survey.
- Enumerators were asked to select the land type, when providing information on all plots within the UAA. In some cases, when a permanent crop was planted in association with a temporary crop, both types of land use existed for a single plot. In these cases, the land use must correspond to the permanent crop.
- The questions related to the perceptions of farmers regarding soil problems must reflect the situation of the country or regions in which the survey is implemented. For example, the farmers in Cartago did not...
report problems with accumulation of salt; some of them found it amusing that they had to answer such a question.

- Information regarding the crop rotation indicator should be retrieved from Q18.8. It should be noted that Q37 is also related to crop rotation; however, during the implementation of the field test, it became clear that this particular question created confusion for both enumerators and respondents. The goal of Q37 is to retrieve information that enables understanding of whether farmers are rotating crops in consideration of a longer period (that is, whether they are following a crop rotation plan over time). Additional clarifications are necessary to establish a clear definition of crop rotation. It is recommendable to use only the reference period, to establish whether rotation is implemented within the UAA and it is thus preferable to omit Q37 from future versions of the module.

- Information on a longer temporal scale could also provide useful information as well; however, the intention of Q37 must be clearly defined to enumerators before the survey is performed, to avoid confusion.

**Irrigation**

**Results**

The following are the main results related to irrigation practices, including the AEIs (table 2).

- Of the 307 holdings surveyed, a total of 29.5 percent reported using full control irrigation methods.

- For the holdings implementing full control irrigation methods, the most common type was sprinkler irrigation, with 69 percent, followed by drip irrigation (42.5 percent). Additional methods included spray or micro sprinklers (4.6 percent), surface irrigation (4.6 percent) and bubbler irrigation (3.4 percent). The full categories of control irrigation methods are not mutually exclusive and more than one method can be selected by respondents; therefore, the percentages reported above do not add up to 100 percent.

- Holdings reported that different water sources were used for irrigation purposes. The most common water source used was the municipal water supply or other water networks (39.4 percent), followed by off-farm surface water (30.9 percent) and on-farm surface water (26.6 percent). Less commonly used were on-farm groundwater (7.4 percent) and harvested rainwater (5.3 percent). The water sources for the categories of

---

8 Q18. Report on the utilized agricultural area (UAA): temporary and permanent crops and grasslands, and temporary fallow
irrigation purposes are not mutually exclusive and more than one water source could be selected by respondents. Therefore, the percentages here do not add up to 100 percent.

- Respondents were asked to report changes in water availability over the last five years. The majority of respondents reported water availability to be more scarce (42.5 percent), while 39.4 percent reported water availability to be the same and 18.1 percent reported water availability to have increased over the last five years.

- The irrigable area is the area that is equipped for irrigation. The irrigated area measures the actual amount of land irrigated.

- The “share of irrigable area of total UAA” indicator corresponded to 9.2 percent, while the “share of irrigated area of total UAA” indicator corresponded to 7.2 percent. In table 5, this indicator is presented separately per type of irrigation method. Sprinkler irrigation cover most of the irrigable and irrigated (5.1 percent and 4.8 percent respectively) areas, followed by drip irrigation (2.8 percent in both cases) (table 5).

- The most efficient irrigation methods were not reported, the most commonly used method being sprinkler irrigation instead of other more efficient methods such as drip, spray or micro-sprinkler or bubbler irrigation. In addition, off-farm municipal water supply or other water networks, and surface water with low or mid environmental impacts, were reported. In general, it is desirable to attain a greater share of the area irrigated with low water-use intensity and high-efficiency irrigation technology, with sources of water related to a lower environmental impact; this is a positive indication of moving towards a more sustainable agricultural production.

### Table 5. AEIs related to water use, for irrigation calculated based on information collected during the field test.

<table>
<thead>
<tr>
<th>Share of utilized agricultural area (%)</th>
<th>Area irrigable</th>
<th>Area irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface irrigation</td>
<td>Sprinkler irrigation</td>
</tr>
<tr>
<td>Permanent crop**</td>
<td>0.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Permanent grasslands**</td>
<td>N/A</td>
<td>29.16</td>
</tr>
<tr>
<td>Temporary crop**</td>
<td>56.2</td>
<td>6.07</td>
</tr>
<tr>
<td>Temporary grasslands**</td>
<td>43.8</td>
<td>64.08</td>
</tr>
<tr>
<td>Temporary fallow**</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**This % are calculated over the actual irrigable or irrigated area. N/A indicates that specific practices were not reported in a certain land use category.

All indicators presented here correspond to a share of the total UAA (2 297.25 ha) that has the potential to be irrigated (irrigable area) and that was actually irrigated (irrigated area). The information included in rows 2-5 corresponds to the percentage of irrigated or irrigable UAA dedicated to specific land uses (permanent crop, temporary crops, etc.).
Issues, comments and recommendations

- It is necessary to better define how to capture the irrigable area when utilizing mobile irrigation equipment.
- It is necessary to standardize the options provided for irrigation systems; currently, there is a discrepancy between the information provided in the CAPI version of the questionnaire and that in the enumerator’s manual.
- Overall, the information collected was useful to calculate the selected indicator, “share of irrigable and irrigated area of total UAA” (table 5).

Fertilizers and pesticides

Results

The following are the main results related to fertilizers and pesticides, including the report on the relevant AEIs.

- Of 307 surveyed holdings, 88.6 percent reported using chemical fertilizers. Four fertilizer types were included. The most common was compound (88.2 percent), followed by straight nitrogenous (51.1 percent), straight phosphatic (12.9 percent) and straight potassic (12.1 percent).
- Of the 272 holdings that reported applying chemical fertilizers, 50.4 percent used only one type of fertilizer, 39 percent applied two types of fertilizers, 6.6 percent applied three types of fertilizers and 4 percent applied all four types of fertilizers included in the categories provided for this question.
- Chemical fertilizers were applied to 78.3 percent of the total UAA. Compound fertilizers were the most commonly applied (71.4 percent), followed by straight nitrogenous (37.3 percent), straight potassic (7 percent) and straight phosphatic (5.4 percent) (table 6).
- Respondents indicated that fertilizers were deemed necessary mainly pursuant to personal observation (77.2 percent). The second reason driving the application of chemical fertilizers was the receipt of technical recommendation from an agronomist (20.6 percent), followed by necessity inferred from post-soil analysis (15.4 percent), technical recommendations from agrochemical companies (9.2 percent) and technical recommendations from extension agencies (5.5 percent).
- Of 307 surveyed holdings, 82.4 percent reported using chemical pesticides. Herbicides were the most commonly used (80.6 percent), followed by fungicides (54.9 percent), insecticides (48.2 percent) and others (24.9 percent).
- Of the 253 holdings reporting the use of chemical pesticides, 43.1 percent used only one type of pesticide, 22.9 percent used two types, 16.2 percent three types and 17.8 percent four types of pesticides.
● Chemical pesticides were applied to 82.2 percent of the total UAA. Herbicides were the most commonly applied (68.6 percent), followed by fungicides (28 percent), insecticides (19.6 percent) and other (6.5 percent) (table 6).

● Respondents indicated that pesticides were deemed necessary mainly pursuant to personal observation (74.3 percent), followed by technical recommendations from an agronomist (19.36 percent), technical recommendations from agrochemical companies (10.3 percent), existing plans on pesticide management application (10.3 percent) and technical recommendations from extension agencies (3.2 percent).

● The use of different labels of pesticides (red, yellow, blue and green) were reported in the holdings surveyed. Holdings within the 2 ha to 5 ha size category reported a greater use of red- (33.9 percent), yellow- (31 percent), and green- (32.8 percent) label pesticides, while holdings lesser than 1 ha in size reported a higher use of blue-label pesticides (31.3 percent).

● In general, the use of chemical fertilizers per unit of area respecting the nutritional demand of crops (that is, without compromising yield) and the use of pesticides per unit area based on economically and technically justified recommendations is desirable, and a positive indication of a shift towards more sustainable agricultural production.

● The results from the field test did not enable proper calculation of the amount of agrochemicals per area. Therefore, the calculations that would allow for identification of whether agrochemical application exceeded or was lower than crop nutritional demand could not be performed. However, the results derived from the field test indicate, first, that a large agricultural area is under the application of fertilizers (1 798.74 ha) and pesticides (1 888.3 ha). Second, the most common reason behind agrochemical applications consists in the farmers’ personal observations (that is, it was not recommended by experts). Third, the use of extremely and highly toxic pesticides (red- and yellow-labelled, respectively) is a common practice among the holdings surveyed. These results indicate that practices having a potentially negative impact on soil health and water quality are commonly implemented, although they may compromise the sustainability of food production.
Table 6. AEIs related to the use of agrochemicals, calculated on the basis of information collected through the field test.

<table>
<thead>
<tr>
<th>Share of utilized agricultural area (%)</th>
<th>Fertilizers</th>
<th>Pesticides</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nitrogenous</td>
<td>Phosphatic</td>
</tr>
<tr>
<td>Permanent crop**</td>
<td>23.5</td>
<td>19.9</td>
</tr>
<tr>
<td>Permanent grasslands**</td>
<td>67.2</td>
<td>9.2</td>
</tr>
<tr>
<td>Temporary crop**</td>
<td>9.3</td>
<td>88.3</td>
</tr>
<tr>
<td>Temporary fallow**</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**This % are calculated over the actual area were agrochemicals are applied. N/A indicates that specific practices were not reported in a certain land use category.

All indicators presented here correspond to the share of total UAA (2 297.25 ha) in which agrochemicals were applied. These indicators differed from those proposed initially, which included references to the amount of agrochemicals used per agricultural area. The various fertilizer and pesticide categories are not mutually exclusive, and the percentages, if added, will not equal to 100 (that is, the first row). The information included in columns corresponding to the percentage of specific agrochemicals applied per land use type will be equal to 100 percent if they are added to one another.

Issues, comments and recommendations

- This was the most challenging section. Several questions on how to annotate or calculate the amount of agrochemicals arose among enumerators. In particular, the enumerators experienced the following difficulties: (i) properly calculating the amount of agrochemicals per unit area (kg/ha or l/ha) when respondents did not directly provide such information; and (ii) selecting the appropriate option of unit per area (kg/ha, kg/m², l/ha, etc.). It is important to note that the collection of these data did not involve the transformation to a single unit per area, which would be a lot more time-intensive. Whenever respondents did not provide an amount for the agrochemicals per unit of area, the enumerators had to divide the total amount of agrochemicals used by the total planted area and select the correct units per area from an existing list.

- Questions related to agrochemical amounts were particularly difficult in the case of annual crops with multiple plantings per year and within a rotation scheme within a set of small plots, as was the case with leafy vegetables (lettuce, chive, carrots, peppers, etc.). These types of crops use significant amounts of inputs and require that data collection be conducted properly. However, they usually represent small areas of land (less than or equal to 1 ha). In the field test, enumerators were asked to collect the agrochemical inputs used per planting when possible, or otherwise estimate the total area of a certain crop planted during the reference year and calculate the total amount of agrochemical used.
during that period, to calculate the amount of inputs per unit of area (ha, or manzanas). The enumerators were asked to indicate in the notes section, whether the amount was per planting or per year; however, this turned out to be a complicated task.

- Ideally, to allow for the collection of reliable data that can be utilized to accurately calculate the proposed agrochemical indicators at a later stage, it is recommended to intensively train enumerators or to hire enumerators that have a strong background in agronomical sciences (students or professionals). However, complying with these particular needs will unequivocally translate in additional costs in terms of time and money for the country implementing the agri-environmental module. Therefore, if the “ideal” is not possible, it is recommended to simplify the data collected. The simplification recommended is to change the level at which questions are asked, from the plot level to the crop level. For example, the total amount of agrochemicals applied per crop type reported within the reference period could be asked. Additionally, respondents are usually able to indicate how much fertilizer or pesticide they have bought or used during the reference period (that is, 12 months prior to the interview) for the different crops grown. The quantities reported could then be easily divided by the planted area of the specific crops, as part of the desktop work (to be done after survey implementation) and obtain robust data related to agrochemical use per crop. If the recommended simplification is to be applied, changes will have to be made to Q31 and Q34 in the PAPI version of the questionnaire (changing from plot to crop level).

- Respondents understood the use of terms such “herbicides”, fungicides” and “insecticides” better than the term “pesticides”, which was often unknown by respondents. It is recommended to adopt commonly used terms when posing questions on agrochemical use; this could entail an additional validation of terminology, considering the specific terminologies in use in the countries of implementation.

- Finally, respondents would often explain the use of a mix of chemical pesticide as a mixture or “cocktail.” The enumerators encountered issues in dealing with how to best annotate this data, especially when reported in a mixture of units (for example, powder pesticides reported in kg mixed with liquid pesticides reported in l). Whenever this situation arises, it was recommended to the enumerators to record the data for the most toxic pesticide included in the mixture, as this bears the greatest impact on the environment.

- Overall, and despite the issues stated above, the information collected was useful to perform calculations on the proportions of UAA where either chemical fertilizers or pesticides were applied. The calculation of
indicators related to the amount of chemical fertilizers and pesticides used per UAA, however, requires a more intensive enumerator training, the use of agronomic background enumerators, or the broader approaches explained above.

5.1.3. Other practices
This section aims to collect specific information about other environmentally relevant practices that are implemented on the holding. There are seven subsections: integrated pest management (IPM), crop rotation, energy from renewable sources, generation and management of solid waste, generation and management of wastewater, water conservation practices, and landscape habitat elements.

Integrated pest management (IPM)
⇒ Results
The following are the main results related to the implementation of IPM.

- Of the 307 holdings surveyed, 40.2 percent reported the use of at least one action related to IPM. Respondents reported implementing an average of 1.8 actions related to IPM.
- The majority of respondents (69.9 percent) reported applying monitoring actions (record pest type, infestation date, location of infestation, weather conditions, etc.). This was followed by 35 percent reporting the implementation of prevention crop cultivation methods (crop rotation, intercropping, use of pest resistant-tolerant cultivars, etc.). 30.1 percent reported the implementation of low-risk methods as the first option for pest control (non-chemical pest control such as biological control, highly targeted chemicals, mechanical control, etc.); 24.4 percent reported conducting an appropriate handling, storage and disposal of pesticides, while a minority share (17.1 percent) reported using a pesticide management plan based on records of previous pesticide application outcomes.
- The majority of respondents (57.7 percent) indicated that the main reason behind the implementation of IPM actions was to reduce the use of pesticides, followed by 24.4 percent applying IPM actions because they could not afford to buy pesticides. Then, 21.1 percent reported being oriented towards biological or organic agriculture, 8.9 percent reported to be looking to enter into a certification scheme, 4.1 percent indicated to be looking to enter into an agricultural cooperative and 35.8 percent selected the “Other” option as a reason for applying IPM actions.
To calculate the indicator, the definition of IPM proposed by FAO and the World Health Organization (WHO, 2014) was used. Using this definition, it was concluded that none of the holdings surveyed truly implemented IPM, but rather only implemented sporadic IPM-related actions. As a result, the indicator “Share of total UAA under IPM actions” was “0”.

The results showed that even though IPM is considered central to the sustainable intensification of crop production and pesticide risk reduction, there was either no use of a genuine IPM approach or a low average number of IPM practices were applied. These results may indicate that no alternative practices are implemented to reduce the current amounts of chemicals applied, which has a potential impact on soil and water quality and thus the sustainability of agricultural production.

### Table 7. AEIs at the farm level related to energy use from renewable sources and management of solid waste.

<table>
<thead>
<tr>
<th>Energy use from renewable sources</th>
<th>Off-farm collection service</th>
<th>Recycling</th>
<th>Burning</th>
<th>Burying</th>
<th>No treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holdings using the practice (%)**</td>
<td>2.3</td>
<td>53.42</td>
<td>41.37</td>
<td>29.97</td>
<td>27.69</td>
</tr>
</tbody>
</table>

*Solid waste management categories are not exclusive and more than one type can be implemented in a single holding.

Here, indicators are related only to the use or non-use of specific practices. The percentage of holdings reporting each practice is shown.

**Issues, comments and recommendations**

- Most respondents were not familiar with the IPM concept; however, they did recognize utilizing different actions or practices considered part of IPM. As IPM implementation is a complex issue, including several actions implemented by the farmer, it is recommended to use simple or colloquial language to explain these activities, without trying to explain the IPM concept.

---

9 “[T]he careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment” (WHO, 2014).
Moreover, it is recommended to use a different approach to assess the IPM indicator, according to which the number of practices within this concept is taken into account, to weight how the farmers’ agricultural production approaches the IPM concept as a whole.

**Energy from renewable sources**

splice|Results
---|---
The following are the main results related to the production and use of renewable energy sources for agricultural activities.

- Of the 307 holdings surveyed, only seven (2.3%) reported producing and using renewable energy for the implementation of agricultural activities (table 7).
- The renewable energy sources reported included biogas (four holdings), solar (two holdings), and biofuel (one holding).
- The absence of energy derived from renewable sources indicates a state of business as usual and, therefore, a greater dependency on fossil fuels for agricultural activities. In traditional agricultural production, irrigation systems and land preparation practices usually rely heavily on vehicles and machinery requiring the use of fossil fuels. Despite these results, this indicator is considered valuable to monitor shifts in production patterns over time. Ideally, in time, more holdings will have access to renewable energy, thus lowering the overall dependence on fossil fuels.

splice|Issues, comments and recommendations
---|---
- No issues were found.
- Overall, the information collected was useful to calculate the selected indicator: “Use of energy from renewable sources” (table 2).

**Generation and management of solid waste**

splice|Results
---|---
The following are the main results related to the generation and management of solid waste within holdings.

- All holdings surveyed reported the implementation of at least one of the solid waste treatment options provided in the survey.
- The most common treatment option among all surveyed holdings reported was the use of an off-farm collection service to take the waste off the holding (53.4 percent), followed by the implementation of recycling (41.4 percent), burning (30 percent), burying (27.7 percent), storage without treatment (17 percent) and disposal directly in the environment (4.3 percent) (table 7). Solid waste management categories are not mutually exclusive and more than one type can be implemented in a single holding.
In general, greater amounts of waste with proper management (that is, waste used for material or energy recovery rather than incineration and disposal in landfills) is desirable, and a positive indication of a shift towards more sustainable agricultural production. Results from this field test show that a greater proportion of waste is taken from the holding by off-farm collection services; this does not provide additional information about the other waste management strategies implemented outside the holding.

Of the waste managed on the farm, the proportion of holdings reporting reutilization of waste (mostly plastic bins for other agricultural purposes) is an indication of desirable management actions. However, the proportion of holdings reporting burning, burying or storage, or disposal of waste without treatment is related to potentially large amounts of waste that are not properly managed, which indicates actions having a potentially negative impact on the environment.

**Issues, comments and recommendations**

- The use of the term “recycling” created confusion between enumerators and respondents, as it included both the reuse and the recycling of materials. Many respondents did not recycle but reported reusing materials. Where recycling was reported, it was usually implemented outside the holdings. It is recommend to use the terms reuse and recycling as separate categories of solid waste management as it will capture the final destination of many materials more adequately.

- Overall, the information collected was useful to calculate the selected indicator, “Management of solid waste from crop production, including plastic, agrochemical and waste from machinery” (table 2).

Generation and management of wastewater

The following are the main results related to the generation and management of wastewater within holdings.

**Results**

- All holdings surveyed reported generating human and agricultural wastewater.
- Of the 307 holdings surveyed, 53 (equivalent to 17.3 percent) reported generating human wastewater. Of those, the majority reported human wastewater to be discharged to a septic or sewer system (83 percent), followed by 11.3 percent reporting it to be “discharged to a constructed retention or holding pond”, 11.3 percent reporting that it was “not managed, removed through natural drainage”, 1.9 percent reporting that it was “discharged into a vegetative filter strip or constructed wetland”,
1.9 percent reporting it being “applied to agricultural land” and 1.9 percent reporting “other” (table 8). Human wastewater treatment categories were not mutually exclusive; therefore, the sum of percentages can exceed 100 percent.

- Of the 307 holdings surveyed, 72 (equivalent to 23.5 percent) reported generating agricultural wastewater. Of those, 54.17 percent corresponded to farms having the main agricultural activity of production of milk from big cattle, followed by farms raising big ruminant livestock for meat (16.67 percent), and farms producing vegetables (12.5 percent). The other 16.67 percent corresponded to farms reporting another main agricultural activity. Most farms reporting that they generated agricultural wastewater (41.7 percent) reported that the agricultural wastewater was applied to agricultural land, 30.6 percent reported that they did not manage these waters but simply had them removed through natural drainage, 13.9 percent reported including them into the liquid manure systems, 11.1 percent reported discharging them to a septic or sewer system, 5.6 percent reported discharging them into a constructed retention or holding pond, and 2.8 percent reported either discharging them into a vegetative filter strip or constructed wetland, or to do “other” respectively (table 8). Agricultural wastewater treatment categories were not mutually exclusive, such that the sum of percentages could exceed 100 percent.

- In general, results showing a majority of holdings conducting a desired form of human wastewater management (sewer systems and retention or holding ponds) is a positive indication of a shift towards a more appropriate disposal of human wastewater, which contributes to sustainable agriculture while reducing risks to the environment and human health. The same is also true of the disposal of agricultural wastewater, the results relating to which indicate that most of holdings that generate wastewater reported reusing these waters and applying them directly onto the fields. This constitutes an indication of a more appropriate use, reuse and disposal of these resources.

**Table 8. AEIs at the farm level related to management of wastewater.**

<table>
<thead>
<tr>
<th>Management of human wastewater (% of holdings)</th>
<th>Discharged to a constructed retention or holding pond</th>
<th>Discharged to a septic or sewer system</th>
<th>Discharged into a vegetative filter strip or constructed</th>
<th>Applied to agricultural land</th>
<th>Included in the liquid manure system</th>
<th>Not managed, removed through natural drainage</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.3</td>
<td>83.0</td>
<td>1.9</td>
<td>1.9</td>
<td>N/A</td>
<td>11.3</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Management of agricultural wastewater (% of holdings)</td>
<td>5.6</td>
<td>11.1</td>
<td>2.8</td>
<td>41.7</td>
<td>13.9</td>
<td>30.6</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Waste water management categories are not exclusive and more than one type can be implemented in a single holding.

These indicators are related to the use or non-use of specific practices; the percentage of holdings reporting each practice is shown.
Issues, comments and recommendations

- No issues were found.
- Overall, the information collected was useful to calculate the selected indicator, “management of wastewater derived from domestic and agricultural activities” (table 2).

Water conservation practices

The following are the main results related to the water conservation practices implemented within surveyed holdings.

Results

- 29.6 percent of the holdings surveyed reported using water conservation practices.
- On average, holdings implemented 1.2 water conservation practices.
- Of the 29.6 percent of holdings implementing these practices, 79.1 percent implement one practice, 19.8 percent implement two practices and only 1.1 percent implement three practices.
- The majority of the holdings implementing water conservation practices reported using rainwater harvesting (62.6 percent), followed by a reduction in transportation losses (17.6 percent). Additional water conservation practices included the use of wastewater for irrigation (13.2 percent), the use of technology to optimize efficiency (8.8 percent), soil moisture conservation practices (12.1 percent) and other (7.7 percent) (table 9). Water conservation practices categories were not mutually exclusive and respondents could choose more than one option; therefore, the sum of percentages could exceed 100 percent.
- The results show that almost 30 percent of all holdings surveyed take the management of water resources into account when implementing their agricultural activities. Of this percentage, 28.57 percent corresponded to farms having the main agricultural activity of producing perennial crops, followed by farms producing milk from big cattle (27.4 percent) and farms producing vegetables (23.08 percent). The other 20.88 percent corresponded to farms reporting another main agricultural activity. All five water conservation options were reported by respondents; however, only an average of 1.2 practices were implemented by holdings.
- In general, the presence and greater diversity of water conservation practices is desirable and a positive indication of a shift towards more sustainable agricultural production. It is important to emphasize that the relatively small number of water conservation practices reported may be the result of the characteristics of the areas surveyed, as the Cartago province does not report water scarcity and fewer practices focusing on
water conservation are thus to be expected. A similar analysis should be conducted in drier areas, where water becomes a limiting factor for agricultural production.

- Additionally, as previously reported in this document, 57.5 percent of holdings reported water availability to be the same or have increased over the last five years.

Table 9. AElS at the farm level related to water conservation practices.

<table>
<thead>
<tr>
<th>Rainwater harvesting</th>
<th>Reduction of transportation losses</th>
<th>Use of wastewater for irrigation</th>
<th>Use of technology to optimize efficiency</th>
<th>Soil moisture conservation practices</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of holdings</td>
<td>62.6</td>
<td>17.6</td>
<td>13.2</td>
<td>8.8</td>
<td>12.1</td>
</tr>
</tbody>
</table>

This indicator is related to the use or non-use of specific practices. The percentage of holdings implementing water conservation practices reporting each practice is shown.

⇒ Issues, comments and recommendations

- No issues were found.
- Overall, the information collected was useful to calculate the selected indicator, “use of water conservation practices” (table 2).

*Landscape habitat elements*

The following are the main results related to the presence of landscape habitat elements within the surveyed holdings.

⇒ Results

- Of the 307 holdings surveyed, a total of 275 (89.6 percent) reported the presence of habitat elements within the boundaries of their properties. The five most common habitat elements reported were hedges or live fences (70 percent), shade or dispersed trees (67.4 percent), riparian forest (25.4 percent), windbreaks (21.2 percent) and secondary forest (13.4 percent). Less commonly reported elements were mature forest (6.5 percent), home gardens (5.5 percent) and forest plantations (4.6 percent).
- The average number of habitat elements per holding was 2.4, with a minimum of 1 and a maximum of 6 out of 8 different habitat element options.
- Of the area of all 307 holdings, 16.3 percent corresponded to land dedicated to home gardens, forest plantations, and mature and secondary forests.
- In general, a greater number (or greater area) of landscape habitat elements is desirable and a positive indication of a shift towards more
sustainable agricultural production. The results show a relatively low average number of habitat elements in the surveyed holdings and a relatively low percentage of total holding area dedicated to non-lineal habitat elements. This could indicate that the low rate of implementation of such practices may compromise biodiversity conservation in these areas and thus long-term food production, that is, a trade-off between increasing farm productivity and minimizing the loss of biodiversity and ecosystem services.

**Issues, comments and recommendations**

- No issues were found.
- Overall, the information collected was useful to calculate the selected indicator “presence of the following landscape elements in the farm: hedges, live fences, dispersed trees, shade trees, forest plantations, home gardens, secondary forest patches, mature forest patches, riparian forests, and windbreaks” (table 2).

**Farm landscape diversity**

The following are the main results related to the farm landscape diversity indicator (table 2).

**Results**

- The mean weighted richness (weighted by holding area) of habitat elements of which the area can be measured, that is, elements that are not linear, and including home gardens, tree plantations, secondary and mature forest, was 2.8.
- The mean weighted richness (weighted by holding area) of habitat elements and croplands was 4.84. The mean weighted value of the Shannon index\(^{10}\) per UAA was 0.74.
- In general, a higher diversity of elements is desired, as it indicates a greater availability of habitat types for biodiversity and thus contributes to the provision of ecosystem services. However, these findings must be analysed considering holding sizes. During this field test, the majority of holdings surveyed were small- or medium-sized, which has a direct

---

\(^{10}\) The Shannon Evenness Index (SHEI) is used to evaluate landscape diversity taking into consideration all observed land cover types (m) and their relative abundance (Pi). The index is based on values within the range of 0 to 1, with 0 representing a landscape with no diversity (only one land cover type) and 1 representing maximum diversity (in other words, featuring all types of land cover in equal amounts). If a landscape is characterized by all different types of land cover being found in equal abundance, then the SHEI will tend towards the value of 1; conversely, if there is only one dominant type of land cover, then the index will tend towards 0.
impact on the number and type of different land uses and land cover present.

⇒ Issues, comments and recommendations
  ● No major issues were found. It must be recalled that the recorded areas rely on the information provided by respondents and may not correspond to the actual sizes on the field.

5.1.4. Livestock

This section collected information about livestock production and the livestock production practices conducted on the holding. It was divided into two subsections: rotational grazing patterns and livestock watering.

Rotational grazing patterns
⇒ Results
The following are the main results related to the implementation of rotational grazing patterns.
  ● 31 percent of holdings reported livestock production as their main agricultural activity, however, a higher percentage, corresponding to 40.7 percent of the total number of holdings, reported conducting livestock production activities.
  ● The total area dedicated to livestock reported by that 40.7 percent of holdings corresponded to 1 487.1 ha, that is, 64.7 percent of total UAA. Of the total area dedicated to livestock, 98.3 percent was under rotational grazing, which corresponds to 63.6 percent of total UAA.
  ● In general, the presence and a greater share of UAA under a rotational grazing scheme is desirable and a positive indication of a shift towards more sustainable agricultural production (that is, one that takes soil health into consideration). Results from the field test indicate that farmers are aware of the potential impact that livestock can have on soils and that, based on that knowledge, they implement actions to prevent its negative effects while moving towards more sustainable agricultural production.
  ● The majority of holdings implementing rotational grazing corresponded to holdings within the 2 ha to 5 ha size range (33.3 percent), followed by holdings within the 5 ha to 10 ha size range (23.3 percent) and the 10 ha to 20 ha and 1-2 ha size range, both with 10.2 percent. Holdings smaller than 1 ha were in the minority, with a reported implementation of rotational grazing in only 5.6 percent of the holdings.
Livestock watering
The following are the main results related to livestock watering practices within holdings.

Results
- Of the 125 (40.7 percent) holdings that reported livestock production as the main agricultural activity, 64 percent indicated that animals do not have free access to natural water sources; while the remaining 36 percent indicated that they do have access to natural watering sources (creeks, streams, rivers, water springs, ponds or lakes).
- The majority of holdings reported using the off-farm municipal water supply or other water networks (55.2 percent) for watering their animals, while 33.6 percent reported relying on on-farm surface water, followed by 14.4 percent reporting to rely on off-farm surface water (that is, lakes, rivers and watercourses). Then, 6.4 percent reported the use of “other” water sources, 4.8 percent reported relying on rainwater harvesting and only 4 percent reported using on-farm ground water sources (boreholes or wells). Water sources for watering animals were not mutually exclusive and the percentage sum could be greater than 100 percent.
- In general, the fact that the majority of holdings reported limited access of livestock to natural water sources is a good indication of a shift towards a more sustainable agricultural production. Limiting livestock access to these sources has a positive impact on the environment and is also related to improved public health, in regions where water from human consumption is drawn from the same water sources. Additionally, the majority of holdings reported using an off-farm municipal water supply, which can be interpreted as being associated with greater control over the amount of water utilized and thus as a positive indicator of the sustainable use of natural resources.
5.2. Lessons learned from the enumerators

Survey implementation, a follow-up workshop conducted with enumerators upon conclusion of the field work and subsequent data processing provided useful insights on items identified as positives (figure 7), as well as issues requiring revision and improvement (figure 6).

Positive feedback
Enumerators emphasized the usefulness of the tools (tablets, the Survey Solutions app, and the Enumerator’s Manual) provided for data collection, ease of use and reliability in terms of information storage. Additional feedback includes the importance of CATIE’s reputation as a solid institution for building trust with farmers prior to the interview. In many cases, farmers were aware of CATIE’s existence and were particularly pleased to participate in the study. Furthermore, an interesting finding was that farmers were not only willing to participate in the study but were also eager to learn more about good agricultural practices. Some even requested to view the results of the study.

Figure 7. Summary of positive feedback from enumerators during the post-field work follow-up workshop. The numbers correspond to the frequency of responses from enumerators who actively participated in data collection and in the post fieldwork workshop.

Issues in need of revision and improvement
Eight major topics were identified as issues in need of improvement, based solely on enumerators’ feedback in light of their experience during data collection. The main area in need of revision is the use of particular words and terminology in specific questions, which proved confusing for respondents and required additional clarification from enumerators. The second major area identified
corresponded to the section dealing with agrochemical use. Issues such as farmers being unable to understand the word “pesticide” were commonly encountered, as well as issues relating to the enumerators when instructing respondents to provide information on the amounts of agrochemical use per agricultural area (figure 8).

General recommendations formulated on the basis of the implementation of the field test include the following:

- It is recommended to use tablets with a 3G system, in which a local telephone company SIM card can be used to acquire holdings’ coordinates easily. Tablets performed well overall and only failed to collect coordinates for 5 of the 207 holdings surveyed. In Costa Rica, the acquisition of cell phone SIM card did not lead to a significant increment in total implementation cost and assured the correct recording of latitude and longitude coordinates, which are relevant to further data collection from spatial layers and spatial landscape analysis.
Conclusions

In general, the two main conclusions from the field test were the following: (1) questions and technical terms were understood by respondents most of the time, meaning that in most cases, the survey questions reflected the country-specific language and situations; and (2) tablets performed well. In addition, skip patterns were consistent with the flow of the questions. Given the amount of time required to complete an interview, it is estimated that an enumerator can reasonably conduct four interviews per day, when the farms are located close to one another (for example, the same village).

Overall, the Enumerator’s Manual reflected the flow of questions of this module, containing a description of the main goals and technical aspects of each section and question of the module. Recommendations for each section of the Manual, as provided in this document, must be taken into consideration, to obtain the best possible data to use when calculating the proposed AEIs.

Data processing and quantitative data analysis enabled identification of critical points that must be considered in future applications of the survey. These include:

- Implementation of the survey in collaboration with a well-known institution, such as CATIE in Costa Rica, has a positive impact on the respondents’ willingness to participate in the survey and creates trust in respondents to answer questions truthfully.
- It is recommended to approach local agricultural or farmer organizations that closely work with farmers in the area to be visited, prior to deploying enumerators. These groups may help enumerators to identify potential farmers to be interviewed and enhance the efficiency of the process of holding identification. Early contact with farmers would secure knowledgeable respondents who are capable of responding to surveys more accurately and in a shorter time.
- In general, respondents were able to answer questions about their agricultural practices implemented within the reference period (12 months prior to the interview). However, it is important that enumerators receive thorough training to ensure that the reference period is properly stated, and that they are able to explain to respondents the importance of limiting their responses to this particular time period. Additionally, proper enumerator training will guarantee an ability to handle situations
in which, for example, recent land use changes have taken place (for example, the holder has changed his or her main agricultural focus from pastures to plantain, or from coffee to maize). In this example, data must be collected for the last agricultural activity if it has been implemented for at least six months.

- The completion time of the survey is long. This was mostly related to the section on agrochemical use, where enumerators had to calculate quantities of agrochemicals per unit of area, a difficult and time-consuming task, especially in conventional agricultural holdings with more than two planted crops and multiple planting throughout the year.

- It is considered that the indicators selected to measure the impact of agricultural production on natural resources are well represented by the sections and questions included in the survey. However, the indicators related to fertilizer and pesticide use presented major challenges and could not be calculated as initially proposed. It is thus recommended to simplify them to the use or non-use of agrochemicals and then use weighting terms such as plot area, crop types and level of toxicity, to obtain a better approximation of fertilizer and pesticide use, and their potential impact on the environment.
References


INEC. 2015. IV Censo Nacional Agropecuario: Resultados generales. INEC Publication: San José.


Annex 1.
Additional results on the percentage of holdings, by categories of holding size, in which different agricultural practices are implemented

Table A1. Agricultural area under conventional, reduced and no tillage practices, by holding size (ha).

<table>
<thead>
<tr>
<th>Size of holding (ha)</th>
<th>Practice</th>
<th>% of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>Conservation tillage</td>
<td>27.3</td>
</tr>
<tr>
<td></td>
<td>Conventional tillage</td>
<td>34.9</td>
</tr>
<tr>
<td></td>
<td>No tillage</td>
<td>48.5</td>
</tr>
<tr>
<td>1-2</td>
<td>Conservation tillage</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>Conventional tillage</td>
<td>32.1</td>
</tr>
<tr>
<td></td>
<td>No tillage</td>
<td>67.9</td>
</tr>
<tr>
<td>2-5</td>
<td>Conservation tillage</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>Conventional tillage</td>
<td>33.3</td>
</tr>
<tr>
<td></td>
<td>No tillage</td>
<td>68.9</td>
</tr>
<tr>
<td>5-10</td>
<td>Conservation tillage</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>Conventional tillage</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>No tillage</td>
<td>74.4</td>
</tr>
<tr>
<td>10-20</td>
<td>Conservation tillage</td>
<td>27.8</td>
</tr>
<tr>
<td></td>
<td>Conventional tillage</td>
<td>16.7</td>
</tr>
<tr>
<td></td>
<td>No tillage</td>
<td>72.2</td>
</tr>
<tr>
<td>20-50</td>
<td>Conservation tillage</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Conventional tillage</td>
<td>16.7</td>
</tr>
<tr>
<td></td>
<td>No tillage</td>
<td>91.7</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>Conservation tillage</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Conventional tillage</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>No tillage</td>
<td>90.0</td>
</tr>
</tbody>
</table>
Table A2. Share of holdings implementing protective soil cover (PSC) practices, by holding size category.

<table>
<thead>
<tr>
<th>Holding area (ha)</th>
<th>PSC practice</th>
<th>% of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>Crop</td>
<td>1.0</td>
</tr>
<tr>
<td>&lt;1</td>
<td>None</td>
<td>16.6</td>
</tr>
<tr>
<td>&lt;1</td>
<td>Plant residues</td>
<td>3.7</td>
</tr>
<tr>
<td>&lt;1</td>
<td>Weeds</td>
<td>2.4</td>
</tr>
<tr>
<td>1-2</td>
<td>Crop</td>
<td>0.7</td>
</tr>
<tr>
<td>1-2</td>
<td>None</td>
<td>14.9</td>
</tr>
<tr>
<td>1-2</td>
<td>Plant residues</td>
<td>4.8</td>
</tr>
<tr>
<td>1-2</td>
<td>Weeds</td>
<td>2.0</td>
</tr>
<tr>
<td>2-5</td>
<td>Crop</td>
<td>1.0</td>
</tr>
<tr>
<td>2-5</td>
<td>None</td>
<td>23.7</td>
</tr>
<tr>
<td>2-5</td>
<td>Plant residues</td>
<td>6.8</td>
</tr>
<tr>
<td>2-5</td>
<td>Weeds</td>
<td>4.1</td>
</tr>
<tr>
<td>5-10</td>
<td>Crop</td>
<td>0.3</td>
</tr>
<tr>
<td>5-10</td>
<td>None</td>
<td>12.2</td>
</tr>
<tr>
<td>5-10</td>
<td>Plant residues</td>
<td>3.1</td>
</tr>
<tr>
<td>5-10</td>
<td>Weeds</td>
<td>0.7</td>
</tr>
<tr>
<td>10-20</td>
<td>Crop</td>
<td>0.7</td>
</tr>
<tr>
<td>10-20</td>
<td>None</td>
<td>4.8</td>
</tr>
<tr>
<td>10-20</td>
<td>Plant residues</td>
<td>0.7</td>
</tr>
<tr>
<td>10-20</td>
<td>Weeds</td>
<td>0.7</td>
</tr>
<tr>
<td>20-50</td>
<td>Crop</td>
<td>0.3</td>
</tr>
<tr>
<td>20-50</td>
<td>None</td>
<td>3.7</td>
</tr>
<tr>
<td>20-50</td>
<td>Plant residues</td>
<td>0.3</td>
</tr>
<tr>
<td>20-50</td>
<td>Weeds</td>
<td>0</td>
</tr>
<tr>
<td>&gt;50</td>
<td>Crop</td>
<td>0</td>
</tr>
<tr>
<td>&gt;50</td>
<td>None</td>
<td>2.7</td>
</tr>
<tr>
<td>&gt;50</td>
<td>Plant residues</td>
<td>0.7</td>
</tr>
<tr>
<td>&gt;50</td>
<td>Weeds</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Table A3. Agricultural area under crop rotation, by holding size (ha).

<table>
<thead>
<tr>
<th>Size of holding (ha)</th>
<th>% of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>29.0</td>
</tr>
<tr>
<td>1-2</td>
<td>29.8</td>
</tr>
<tr>
<td>2-5</td>
<td>23.7</td>
</tr>
<tr>
<td>5-10</td>
<td>11.1</td>
</tr>
<tr>
<td>10-20</td>
<td>15.8</td>
</tr>
<tr>
<td>20-50</td>
<td>16.7</td>
</tr>
<tr>
<td>&gt;50</td>
<td>16.7</td>
</tr>
</tbody>
</table>
Table A4. Total irrigable and irrigated UAA, by holding size (ha).

<table>
<thead>
<tr>
<th>Size of holding (ha)</th>
<th>Holding (irrigable) (%)</th>
<th>% of holdings (irrigated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>39.39</td>
<td>39.4</td>
</tr>
<tr>
<td>1-2</td>
<td>32.14</td>
<td>32.1</td>
</tr>
<tr>
<td>2-5</td>
<td>38.89</td>
<td>35.6</td>
</tr>
<tr>
<td>5-10</td>
<td>13.95</td>
<td>14.0</td>
</tr>
<tr>
<td>10-20</td>
<td>16.67</td>
<td>16.7</td>
</tr>
<tr>
<td>20-50</td>
<td>25.00</td>
<td>16.7</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table A5. Agricultural land under water conservation practices, by holding size (ha).

<table>
<thead>
<tr>
<th>Holding size (ha)</th>
<th>% of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>23.1</td>
</tr>
<tr>
<td>1-2</td>
<td>15.4</td>
</tr>
<tr>
<td>2-5</td>
<td>30.8</td>
</tr>
<tr>
<td>5-10</td>
<td>12.1</td>
</tr>
<tr>
<td>10-20</td>
<td>6.6</td>
</tr>
<tr>
<td>20-50</td>
<td>4.4</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>7.7</td>
</tr>
</tbody>
</table>
### Table A6. Forested landscape habitat elements, by holding size (ha).

<table>
<thead>
<tr>
<th>Size of holding (ha)</th>
<th>Forested habitat type</th>
<th>% of holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>Riparian forest</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>Secondary forest</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mature forest</td>
<td>0</td>
</tr>
<tr>
<td>1-2</td>
<td>Riparian forest</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Secondary forest</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>Mature forest</td>
<td>1.0</td>
</tr>
<tr>
<td>2-5</td>
<td>Riparian forest</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>Secondary forest</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Mature forest</td>
<td>1.6</td>
</tr>
<tr>
<td>5-10</td>
<td>Riparian forest</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>Secondary forest</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>Mature forest</td>
<td>1.6</td>
</tr>
<tr>
<td>10-20</td>
<td>Riparian forest</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Secondary forest</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Mature forest</td>
<td>0.3</td>
</tr>
<tr>
<td>20-50</td>
<td>Riparian forest</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Secondary forest</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Mature forest</td>
<td>0.3</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>Riparian forest</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>Secondary forest</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Mature forest</td>
<td>1.6</td>
</tr>
</tbody>
</table>

### Table A7. Number of IPM practices implemented by holdings.

<table>
<thead>
<tr>
<th>IPM practices</th>
<th>% holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>52.9</td>
</tr>
<tr>
<td>2</td>
<td>26.0</td>
</tr>
<tr>
<td>3</td>
<td>15.5</td>
</tr>
<tr>
<td>4</td>
<td>3.3</td>
</tr>
<tr>
<td>5</td>
<td>2.4</td>
</tr>
</tbody>
</table>
Table A8. Holdings (%) utilizing label colours of pesticides, by holding size categories.

<table>
<thead>
<tr>
<th>Holding area (ha)</th>
<th>Green</th>
<th>Blue</th>
<th>Yellow</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 (n=58)</td>
<td>56,9</td>
<td>17,2</td>
<td>60,3</td>
<td>27,6</td>
</tr>
<tr>
<td>1-2 (n=45)</td>
<td>44,4</td>
<td>13,3</td>
<td>73,3</td>
<td>26,7</td>
</tr>
<tr>
<td>2-5 (n=78)</td>
<td>53,8</td>
<td>7,7</td>
<td>67,9</td>
<td>26,9</td>
</tr>
<tr>
<td>5-10 (n=33)</td>
<td>48,5</td>
<td>9,1</td>
<td>72,7</td>
<td>15,2</td>
</tr>
<tr>
<td>10-20 (n=19)</td>
<td>47,4</td>
<td>26,3</td>
<td>68,4</td>
<td>26,3</td>
</tr>
<tr>
<td>20-50 (n=10)</td>
<td>30</td>
<td>10</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>&gt;50 (n=10)</td>
<td>50</td>
<td>10</td>
<td>50</td>
<td>10</td>
</tr>
</tbody>
</table>

n within parenthesis represents the number of holdings within each holding size category reporting the use of any type of pesticide (fungicide, herbicide, insecticide and other). Holdings could report more than one colour of pesticide, thus rows does not add up to 100%.
Annex 2.

PAPI version of survey
### 1.2 Identification of the Holding

7. Record the following information about the holder/co-holder only if person in 5 is not the holder/co-holder
   a. First name(s)________________________
   b. Surname(s)_________________________
   c. Sex  
      - 1 Male  
      - 2 Female
   d. Address  
      - Street________________________
      - Village, town________________________
      - County________________________
      - Province________________________
   e. Main telephone number________________________
   f. E-mail________________________

8. Name of the holding________________________

9. Address of the holding
   a. Same as the address of the holder → Go to 10
   b. Different from the address of the holder → Go to 11

10a. GPS coordinates corresponding to the main entrance of the holding
   - Latitude________________________
   - Longitude________________________

10b. GPS coordinates corresponding to the middle of the main used plot of the holding
   - Latitude________________________
   - Longitude________________________

### 1.3 Agricultural Activity

11. What is the holding's main agricultural focus? [Answer must be based on the activity that generates the highest economic income, not on the time spent on such activity] [Rabbits, poultry and insects are not considered as part of livestock] [Select one option only]
   - 1 Crop production → Go to 12
   - 2 Livestock production → Go to 13

12. What is the main cropping activity? [The main cropping activity is the one that generates the highest economic income] [Select one option only]
   - 1 Production of annual crops (e.g., maize, beans, rice, potatoes, cassava, peanut, tobacco, cotton, etc.)
   - 2 Production of vegetables (e.g., cabbage, lettuce, green beans, zucchini, etc.), mushrooms, flowers, ornamental plants
   - 3 Production of fruits (e.g., apples, banana, mango, pineapple, passion fruit, palm oil, etc.)
   - 4 Production of other perennial crops (cocoa, coffee, palm oil, etc.)

13. What is the main livestock activity? [The main livestock activity is the one that generates the highest economic income] [Select one option only]
   - 1 Raising big ruminant livestock for meat (bovines, equines, buffaloes)
   - 2 Raising small ruminant livestock for meat (sheep, goats)
   - 3 Raising non-ruminant livestock for meat (pigs)
   - 4 Production of milk (big cattle)
   - 5 Production of milk (small cattle)
### Agricultural Production

**14. What is the total holding area?**

<table>
<thead>
<tr>
<th>Area</th>
<th>Unit of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**15. Please indicate the area of the holding used for agricultural production and other land purposes**

- [ ] Utilized agricultural area (UAA: temporary crops and grasslands, permanent crops and grasslands, and temporary fallow)
- [ ] Farm buildings and farmyards
- [ ] Forest and other wooded land (e.g. mature forest, secondary forest, young vegetation regrowth, tree plantations)
- [ ] Aquaculture
- [ ] Other land (e.g. unutilized, rocks, wetland, etc.)

**16. Did you perform agricultural activities in land outside the farm (owned, rented, borrowed or communal land)?**

- [ ] No
- [ ] Yes

**16a. Please indicate the total area outside the holding where you performed agricultural activities**

<table>
<thead>
<tr>
<th>Area</th>
<th>Unit of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**17. How many plots did you use for agricultural production?**

<table>
<thead>
<tr>
<th>Plot ID</th>
<th>Plot area</th>
<th>Unit of measure</th>
<th>Crop or grass name</th>
<th>Land use (at the end of the survey)</th>
<th>Crop condition 1. Alone 2. Associated 3. On a rotation scheme</th>
<th>Number of plantings</th>
<th>Crop area</th>
<th>Unit of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total utilized agricultural area (UAA)**

Unit of measure: 1. Hectares, 2. Square meters, 3. Local unit (specify ________)

**18. Did you raise livestock (Rabbits, poultry and insects are not considered as part of livestock)?**

- [ ] No
- [ ] Yes
### 3.1 Soil Management

#### 23. Did you implement tillage?
- [ ] 1 No (Go to Q21)
- [ ] 2 Yes

#### 23a. Tilling type
1. Conventional
2. Conservation
3. None

#### 23b. Protective soil cover type
1. Plant residue
2. Cover / intermediate crop
3. Reseeded crop
4. Plant residues and cover crop
5. Weeds
6. None

#### 23c. Time of permanence of protective soil cover
- [ ] 1 Day
- [ ] 3 Days
- [ ] 3 Weeks
- [ ] 3 Months

---

#### 24. Did you implement agricultural burning?
- [ ] 1 No (Go to Q25)
- [ ] 2 Yes

#### 24a. Reasons for implementing agricultural burning (Select all that apply)
- [ ] Reduce crop residue
- [ ] Maintain or increase productivity
- [ ] Pest or disease control
- [ ] Reduce unwanted plant species
- [ ] Cultural reasons
- [ ] Other (specify)
- [ ] No burning was implemented
### 3.1 SOIL MANAGEMENT

#### 23. Do you implement any other soil erosion control practices?
- [ ] 1. No (Go to Q24)
- [ ] 2. Yes

#### 23x. Please select implemented soil erosion control practices [Select all that apply]

<table>
<thead>
<tr>
<th>Line</th>
<th>Agronomic practices</th>
<th>Vegetative practices</th>
<th>Structural practices</th>
<th>Management practices</th>
<th>Other (specify)</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

24. Over the last 5 years, did you notice loss of soil by washing or wind blowing in your farm? [Select one option only]
- [ ] 1. Yes, the problem affects half of my farm or more
- [ ] 2. Yes, but less than half of my farm is affected
- [ ] 3. No, I am not aware of such problem
- [ ] 4. The problem existed but the situation has improved

25. Over the last 5 years, did you notice a reduction in the fertility of your soil (production is reducing, and/or you have had to abandon part of your land because it is not any more productive)? [Select one option only]
- [ ] 1. Yes, the problem affects half of my farm or more
- [ ] 2. Yes, but less than half of my farm is affected
- [ ] 3. No, I am not aware of such problem
- [ ] 4. The problem existed but the situation has improved

26. Over the last 5 years, did you notice excessive accumulation of water on part of your holding that affects production (production is reducing, and/or you have had to abandon part of your land because it is not any more productive)? [Select one option only]
- [ ] 1. Yes, the problem affects half of my farm or more
- [ ] 2. Yes, but less than half of my farm is affected
- [ ] 3. No, I am not aware of such problem
- [ ] 4. The problem existed but the situation has improved

27. Over the last 5 years, did you notice accumulation of salt on the surface of your soil which affects its productivity (production is reducing, and/or you have had to abandon part of your land because it is not any more productive)? [Select one option only]
- [ ] 1. Yes, the problem affects half of my farm or more
- [ ] 2. Yes, but less than half of my farm is affected
- [ ] 3. No, I am not aware of such problem
- [ ] 4. The problem existed but the situation has improved
3.2 Irrigation

28. Did you have agricultural area with fully control irrigation equipment or infrastructure?
   - 1. No
   - 2. Yes

29. Report on the agricultural area that was equipped with fully control irrigation equipment or infrastructure, the area that was actually irrigated, and the irrigation types used. Please indicate the frequency of irrigation and the season during which it was irrigated.

<table>
<thead>
<tr>
<th>Plot ID</th>
<th>Area equipped</th>
<th>Area irrigated</th>
<th>Unit of measurement and area irrigated</th>
<th>Irrigation types and percentage of area irrigated</th>
<th>Time unit</th>
<th>Irrigated during season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Rectangular</td>
<td>1. Surface (flood, furrows)</td>
<td>1. Day</td>
<td>1. Rain</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Spray or micro sprayer</td>
<td>4. Bubblers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5. Flood</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

29a. Identify the sources of water that were used for irrigation and indicate their importance in relation to the entire irrigated area (Select all that apply)

<table>
<thead>
<tr>
<th>WATER SOURCE</th>
<th>Importance (% of total irrigated area)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On-farm ground water (borehole or well)</td>
<td></td>
</tr>
<tr>
<td>2. On-farm surface water</td>
<td></td>
</tr>
<tr>
<td>3. Off-farm surface water (lakes, rivers, water courses)</td>
<td></td>
</tr>
<tr>
<td>4. Off-farm municipal water supply or other water networks</td>
<td></td>
</tr>
<tr>
<td>5. Harvested rainwater</td>
<td></td>
</tr>
</tbody>
</table>

29b. Comparing the reference period with the past five years, do you consider that water available for irrigation is: (Select one option only)

- 1. More abundant
- 2. More scarce
- 3. The same
- 4. Don't know
### 3.3 Fertilizers

<table>
<thead>
<tr>
<th>Plot ID</th>
<th>Crop or grass name</th>
<th>Compound NPK, NP, PK, NK</th>
<th>Straight nitrogenous N</th>
<th>Straight phosphatic P₂O₅, P</th>
<th>Straight potassic K₂O, K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Quantity</td>
<td>Unit/area</td>
<td>Quantity</td>
<td>Unit/area</td>
</tr>
<tr>
<td>01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3.4 Pesticides

<table>
<thead>
<tr>
<th>Plot ID</th>
<th>Crop or grass name</th>
<th>Fungicide</th>
<th>Herbicide</th>
<th>Insecticide</th>
<th>Other (fungicides, bactericides, molluscides, nematocides, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Quantity</td>
<td>Unit/area</td>
<td>Label color</td>
<td>Quantity</td>
</tr>
<tr>
<td>01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unit of measure: 1 lb/ac, 2 kg/ac, 3. lt/ac, 4. Other (Specify: )
35. Was the application of chemical pesticides based on any of the following reasons? [Select all that apply]
- 1. Pesticides were needed (holder's personal observation)
- 2. Technical recommendation from agronomist
- 3. Technical recommendation from extension agencies
- 4. Technical recommendation from agrochemical companies
- 5. An existing plan on pesticide management

4.1 INTEGRATED PEST MANAGEMENT
36. Which of the following practices did you implement? [Select all that apply]
- 1. Monitoring actions (record pest type, identification data, location of infestation, weather conditions, degree of damage)
- 2. Prevention crop cultivation methods: crop rotation, intercropping, use of pest resistant/tolerant cultivars, planting pest-free rootstocks, hand weeding, pruning, others
- 3. Low risk methods as a first option for pest control: non-chemical pest control (biological control, biopesticides), highly targeted chemicals (pest specific), mechanical control (trapping, weeding, hand removal), others
- 4. Appropriate handling, storage and disposal of pesticides: trained personnel for pesticide application, protective equipment for pesticide application, designated areas for pesticides disposal and/or cleaning of equipment for pesticide application
- 5. Use or design of a pestcontrol management plan based on records of previous pesticide application outcome
- 6. None of the above - Go to Q35

36a. Select the reason(s) for the implementation of the above selected practice(s)
- 1. Cannot afford to buy pesticides
- 2. Aims to reduce the use of pesticides
- 3. Looking to enter into a certification scheme
- 4. Looking to enter an agricultural cooperative
- 5. Have a biological or organic agriculture orientation
- 6. Other (Specify)

4.2 CROP ROTATION
37. Was crop rotation implemented in a period longer than the reference period?
- 1. No (Go to Q30)
- 2. Yes

4.3 ENERGY FROM RENEWABLE SOURCES
38a. Identify which type(s) of energy from renewable sources were produced within the holding and used for activities related to agricultural production [Select all that apply]

<table>
<thead>
<tr>
<th>Energy type</th>
<th>Electricity generation</th>
<th>Drying</th>
<th>Water pumping and/or transportation</th>
<th>Heating</th>
<th>Machinery use</th>
<th>Other (Specify)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Solar</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
</tr>
<tr>
<td>2. Wind</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
</tr>
<tr>
<td>3. Water</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
</tr>
<tr>
<td>4. Biofuels/biodiesel</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
</tr>
<tr>
<td>5. Biogas (from manure)</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
</tr>
<tr>
<td>6. Charcoal/fuel wood</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
</tr>
<tr>
<td>7. Other (Specify)</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
<td>[]</td>
</tr>
</tbody>
</table>
4 OTHER PRACTICES

4.4 GENERATION AND MANAGEMENT OF SOLID WASTE

39. Identify which type(s) of solid waste were generated by agricultural activity and the final treatment

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Waste taken away from the holding by off-farm collection service</th>
<th>Burning</th>
<th>Burning</th>
<th>Directly to the environment (no treatment)</th>
<th>Storage (no treatment)</th>
<th>Recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Non-functioning vehicles (tractors, agricultural machinery)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Used ties</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Waste oils (black oils and hydraulic oils)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Empty packaging of pesticide products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Empty packaging of fertilizer products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Empty packaging of diesel, gasoline or other petroleum products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Empty packaging of cleaning and disinfection products</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Empty packaging of seeds (bags and containers of all sizes and materials)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Used plastic film</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Ropes and net (used for forage conditioning or viticulture)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Pesticides that are no longer usable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Veterinary waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Dead animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.5 GENERATION AND MANAGEMENT OF WASTEWATER

40. Was wastewater generated by the holding?
   ○ 1 No (go to Q41)  ○ 2 Yes

Identify wastewater generated by the holding and the final treatment [Select all that apply]

<table>
<thead>
<tr>
<th>Human Wastewater</th>
<th>Discharged to a constructed retention or holding pond</th>
<th>Discharged to a septic or sewer system</th>
<th>Discharged into a vegetative filter strip or constructed wetland</th>
<th>Applied to agricultural land</th>
<th>Included in the liquid manure system</th>
<th>Net managed, removed through natural drainage</th>
<th>Other (Specify: )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural wastewater (from livestock or other productive activities on the holding)</td>
<td>Discharged to a constructed retention or holding pond</td>
<td>Discharged to a septic or sewer system</td>
<td>Discharged into a vegetative filter strip or constructed wetland</td>
<td>Applied to agricultural land</td>
<td>Included in the liquid manure system</td>
<td>Net managed, removed through natural drainage</td>
<td>Other (Specify: )</td>
</tr>
</tbody>
</table>

4.6 WATER CONSERVATION PRACTICES

41. Did you implement any type of water conservation practices?
   ○ 1 No (Go to Q42)  ○ 2 Yes

41a. Please indicate implemented water conservation practices [Select all that apply]
   ○ 1 Modification of agricultural practices (e.g. mulching, reduced or minimum tillage, use of soil vegetative cover, use of crop species and varieties resistant to drought and adapted to local climates)
   ○ 2 Improving irrigation efficiency (e.g. use of efficient irrigation technology, use of soil moisture and rainfall sensors to optimize irrigation schedules)
   ○ 3 Reduction of transportation losses
   ○ 4 Rainwater harvesting
   ○ 5 Use of wastewater for irrigation
   ○ 6 Other (Specify: )
4.7 Landscape Habitat Elements

43. Identify which of the following landscape habitat elements were present in the holding. Please provide best area estimations you can only for non-linear habitats [Select all that apply]

- 1. Hedges and live fences
- 2. Windbreaks
- 3. Shade or dispersed trees
- 4. Riparian forest
- 5. Home gardens
- 6. Tree plantations
- 7. Secondary forest
- 8. Mature forest
- 9. Farm

Area: ____________________________
Unit of area: ___________________

5. Livestock Production

TEXT TO READ: This section of the survey is about livestock under the responsibility of the holder in plots outside and inside the holding. Report for all animals regardless of ownership, including those that are boarded, owned by another member of the household, custom-fed or fed under contract. Horses, poultry and insects are not considered.

44. Report the type of livestock raised during the reference period [Select all that apply]

| Livestock type          | Number of animals | Purpose
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Bovines (cattle)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Buffalo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Camels or camaits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Goats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Other ruminants [specify: ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Pigs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

45. Please provide the total area dedicated to livestock

Area: ____________________________
Unit of measure: ___________________

46. Did you implement rotational grazing on your agricultural land?

- 1. Yes (0 to 0.87)
- 2. Yes

5.1 Rotational Grazing Patterns

- a. Area. Could you indicate the average resting period?

<table>
<thead>
<tr>
<th>Resting period</th>
<th>Period unit</th>
<th>Time unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1. Days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Months</td>
</tr>
</tbody>
</table>

b. Indicate the number of plots in which you rotate the livestock
### 5 LIVESTOCK PRODUCTION

#### 5.2 LIVESTOCK WATERING

**5.3. Identify which source(s) of water were used for watering livestock, indicate if water source was used or not across all seasons and its importance in relation to the entire use of animal watering in the holding. [Select all that apply]**

<table>
<thead>
<tr>
<th>Water source</th>
<th>Season</th>
<th>Importance of water source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On-farm ground water (borehole or well)</td>
<td>1. Rainy</td>
<td>1. Not used very often (between 54-8% of the times)</td>
</tr>
<tr>
<td></td>
<td>2. Dry</td>
<td>2. Used in a significant amount (between 50-60% of the times)</td>
</tr>
<tr>
<td></td>
<td>3. Both</td>
<td>3. Main watering source (more than 90% of the times)</td>
</tr>
<tr>
<td>2. Off-farm surface water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Off-farm municipal water supply or other water networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Rainwater harvesting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Other (Specify: )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**48. Comparing the reference period with the past five years, do you consider that water availability for watering animals is: [Select one option only]**

- 1. More abundant
- 2. More scarce
- 3. The same
- 4. Don’t know

**49. Do animals have free access to natural watering sources (creek, stream, river, water spring, pond, lake)?**

- 1. Yes
- 2. No

---

### TYPE OF AGRICULTURAL LAND

1. Temporary crops under greenhouses or high shelters
2. Temporary crops outdoor or under low shelters
3. Temporary fallow
4. Temporary grasslands
5. Kitchen gardens and backyards
6. Permanent crops under greenhouses or high shelters
7. Permanent crops outdoors or under low shelters
8. Permanent grasslands

---

### FERTILIZERS

<table>
<thead>
<tr>
<th>Compound fertilizers</th>
<th>Nutrients</th>
<th>Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPK fertilizers</td>
<td>15% N, 15% P2O5 and 15% K2O</td>
<td>15% N, 15% P2O5 and 15% K2O</td>
</tr>
<tr>
<td>Diammonium phosphate</td>
<td>16% N and 46% P2O5</td>
<td>16% N and 46% P2O5</td>
</tr>
<tr>
<td>Monosodium phosphate</td>
<td>11% N and 52% P2O5</td>
<td>11% N and 52% P2O5</td>
</tr>
<tr>
<td>Other NP compounds</td>
<td>20% N and 20% K2O</td>
<td>20% N and 20% K2O</td>
</tr>
<tr>
<td>Potassium nitrate</td>
<td>13% N and 64% K2O</td>
<td>13% N and 64% K2O</td>
</tr>
<tr>
<td>Other NK compounds</td>
<td>20% N and 20% K2O</td>
<td>20% N and 20% K2O</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compound</th>
<th>Nutrients</th>
<th>Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>46% N</td>
<td>Phosphate rock 30% P2O5</td>
</tr>
<tr>
<td>Ammonium sulphate</td>
<td>23% N</td>
<td>Superphosphates above 20% 46% P2O5</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>33.3% N</td>
<td>Superphosphates, other 20% P2O5</td>
</tr>
<tr>
<td>Calcium ammonium nitrate and other mixtures with calcium carbonate</td>
<td>20% N</td>
<td>Other phosphatic fertilizers, n.e.c. 20% P2O5</td>
</tr>
<tr>
<td>Sodium nitrate</td>
<td>16% N</td>
<td>Straight potassium fertilizers Nutrients</td>
</tr>
<tr>
<td>Urea and ammonium nitrate solutions</td>
<td>32%</td>
<td>Potassium chloride (muriate of potash) 60% K2O</td>
</tr>
<tr>
<td>N Ammonium, anhydrous</td>
<td>82% N</td>
<td>Potassium sulphate (sulphate of potash) 50% K2O</td>
</tr>
<tr>
<td>Other nitrogenous fertilizers, n.e.c.</td>
<td>20% N</td>
<td>Other potassium fertilizers, n.e.c. 20% K2O</td>
</tr>
</tbody>
</table>

---

Finish time: __________________________

Date: __________________________
1. Objective of the module and the field test

The type of agricultural practices implemented for crop and livestock production play a major role in the impact that agriculture has on the environment. The impact of agriculture on the natural resources on which it relies must be urgently assessed, in order to design and apply actions towards a more sustainable food production worldwide.

This agri-environmental module has been designed with the main goal of collecting information about the state of critical natural resources that are necessary to foster sustainable agricultural production. This survey has been designed to be applied either as a stand-alone survey or as a module in an agricultural survey. The inclusion of this module within national agricultural surveys will support the development of a standardized statistical methodology, to help monitor whether agricultural practices are producing a negative impact on the environment or whether they are contributing towards a more sustainable agricultural production.

The aim of this pilot test is to test the survey for the module, to identify potential problems for both respondents and enumerators, for example with regard to the wording of questions and skip patterns, and to evaluate alternative ways of measuring variables of interest and conducting the interview. With the aim of collecting good-quality data under given budget and time constraints, the results of the test will inform the final version of the survey and related guidelines on how to incorporate an agri-environmental module into existing agricultural surveys.

2. Module design

This survey on the relationships between agricultural production and the environment comprises five sections: 1) THE HOLDING; 2) AGRICULTURAL
PRODUCTION; 3) PRODUCTION PRACTICES; 4) OTHER PRACTICES; and 5) LIVESTOCK PRODUCTION on the holding. The first section aims to collect general information about the holding and the holder and is divided into three subsections: 1.1) survey preparation; 1.2) identification of the holding; and 1.3) agricultural activity. The second section collects general information about the agricultural production conducted on the holding. The third section seeks to collect specific information about the agricultural practices implemented on the holding and is divided into four subsections: soil management, irrigation, fertilizers and pesticides. The fourth section collects specific information about other environmental relevant practices being implemented on the holding and is divided in seven subsections: integrated pest management (IPM), crop rotation, energy from renewable sources, generation and management of solid waste, generation and management of wastewater, water conservation practices, and landscape habitat elements. Finally, the fifth section aims to collect information about livestock production and livestock production practices being conducted on the holding and is divided in two subsections: rotational grazing patterns and livestock watering.

The main goal of all sections and subsections included in the survey is to evaluate, in an orderly manner, different aspects of agricultural production practices that may negatively impacting crucial natural resources: soil, water, land, biodiversity and climate. All evaluations MUST BE performed considering the established reference period, which corresponds to the last twelve months prior to the moment of survey application. Therefore, we are collecting information about activities that were implemented on the holding during the last twelve months.

3. Survey application

Prior to the application of the survey, the person conducting the survey [the enumerator] will explain the person answering the survey [from now on the respondent] all pertinent information related to the task ahead. The enumerator MUST share the following information with the respondent:

“This module has been developed by the Global Strategy to improve Agricultural and Rural Statistics in collaboration with the Tropical Agricultural Research and Higher Education Center (CATIE), which is located on the Turrialba valley in Cartago. The module has been revised in collaboration with the National Institute of Statistics and Censuses of Costa Rica (INEC). Data collected through this survey will foster understanding of the extent to which common practices regularly implemented during crop and livestock production directly or indirectly have an impact on natural resources, as well as guide decision- and
policy-making for a more sustainable food production. The results of this field test will help to improve the phrasing, flow and number of questions currently included, to find the best possible way to measure variables of interest, and to adapt the module to local circumstances. It is important to note that, although this module is intended to be incorporated into existing agricultural surveys, this field test will only consider the question of the interaction between agriculture and the environment.”

An important aspect to be considered is the selection of the right respondent. The person to be interviewed should be the most knowledgeable person in the holding with regard to crop and livestock production. This person may be the holder, co-holder, manager or any employee able to answer questions for the agricultural holding. If two people are identified as being necessary for a complete view of the holding’s production activities (for example: one for crop management and another one for livestock management), both should be interviewed applying the necessary adjustments, meaning that each of them will only be asked the questions of the relevant section of the module. For instance, the person knowledgeable about crops WILL ONLY answer questions dealing with crop production and the person knowledgeable about livestock production WILL ONLY answer questions dealing with livestock production.

To properly apply this module, questions MUST BE asked exactly as worded; changing words or phrases, or adding or dropping words must be avoided. Also, unless in presence of a skip pattern, the question must always be asked, even when the answer is obvious to the enumerator: filling the answer without asking the question must be avoided at all times. Always allow respondents to provide an answer of their own.

Moreover, remember that your role as enumerator must be nothing but that of an observer. Therefore, you must avoid giving opinions or recommendations about the actions carried out on the farm. The enumerator must be respectful at all times and avoid commenting on what has been observed or about information that the respondent has shared. If the respondent requests information or advice on a particular practice, the enumerator must refer him or her to the corresponding organization (if known) and avoid making recommendations or suggestions. The enumerator must avoid, at all times, making judgments about the actions implemented on the farm.

Finally, if after entering the farm, the enumerator makes observations that contradict the respondent’s statements, the enumerator must avoid making comments that point out these inconsistencies. The enumerator is not there to judge and is not visiting the farm to supervise the correct application of practices.
The information provided by the respondent must be recorded in the survey even when a conflict exists with what has been observed by the enumerator. That is, the enumerator must not change the answers given by the respondent based on his or her own observations. In these cases, the enumerator must include a note to inform supervisors about the inconsistencies; however, the information provided by the respondent must be kept as it is, without any changes.

SECTION 1. THE HOLDING

The holding, agricultural holding or farm is a single unit, both technically and economically, operating under a single management and which undertakes agricultural activities either as its primary or secondary activity. Other supplementary (non-agricultural) products and services may also be provided by the holding (Eurostat, 2017).

The holder of the agricultural holding is the natural person, group of natural persons or legal person on whose account and in whose name the holding is operated and who is legally and economically responsible for the holding, that is, who takes the economic risks of the holding (Eurostat, 2017).

SUBSECTION 1.1 SURVEY PREPARATION

This section aims to collect relevant information about the enumerator [name, enumerator number or ID, etc.] and basic information such as the date of survey application and the start time of survey application. Please make sure to write down the date and start time, as this information is important to evaluate whether the survey length is appropriate or if it is necessary to shorten it to facilitate its application.

After filling in the enumerator’s personal information, date of survey application and start time, please answered Q01 and Q02. These two questions must be answered by the enumerator.

Q01. Was a farm or holding found at the address provided?
Filter question. If the answer is No, stop the survey: it will be impossible to apply the survey without being able to locate the proper holding. If the answer is Yes, go to Q02.
Q02. Was someone from the farm or holding found who accepted responding to the survey?
Filter question. If the answer is No, stop the survey. If you are able to find a knowledgeable person but he or she refuses to collaborate with the survey, stop the survey. If the answer is Yes, move to Q03.

Q03. Did the holding grow any crops, or raised animals during the reference period?
Filter question. If the answer is No, stop the survey. If the answer is Yes, introduce the survey using the text below (TEXT TO READ) and continue the survey.

[Remember that all questions MUST BE answered considering the established reference period, which corresponds to the last twelve months prior to the moment of survey application. This means that we are collecting information about activities that were implemented on the holding in the last twelve months.]

TEXT TO READ:

I represent the [SURVEY INSTITUTE]. We are conducting a survey about agricultural practices in different regions of [COUNTRY]. This survey aims to add to ongoing efforts such as the national agricultural surveys to better understand the relationships between agricultural production and the environment. To have a better idea of the real situation, we need to learn about different agricultural practices implemented by thousands of holdings of various types and from different geographical regions. Only after summarizing all of the responses can we have an accurate understanding of the impact of agricultural production on the environment in [COUNTRY].

This survey has been created to obtain information about agricultural practices implemented in farms at national level, including all sizes and all agricultural activities. The questions included here will focus mainly on the practices implemented for crop and livestock production, including soil management, irrigation, fertilizers, pesticides, other practices and livestock production, including rotational livestock patterns and animal watering. **Answers must be given considering the reference period established for this survey, which corresponds to the last twelve months before the survey application.**

For that purpose, [NUMBER] holdings have been chosen at random, like in a lottery. One of these holdings proved to be yours. The authenticity of the results of the whole survey will depend on your sincerity and exactness when answering the questions included in this survey. The survey length is of approximately 50
minutes; however, it can last more or less, depending on the number of crops and agricultural practices that you implement on your farm. We assure you that your personal responses will not be disclosed or shared with anyone and that after all these surveys are processed by a computer, they will be used only in a summary way. This means that the information provided by each holding will be aggregated and only presented and shared as a summary. For instance, we will report the percentage corresponding to each tillage practice category for the production of specific crops across holdings, and never specific information on a particular holding, the names of holdings or the names of holding owners.

If you have any questions regarding this survey, you are welcome to telephone the number indicated on the visit card of our organization that I leave you here.

I express my gratitude for your acceptance to participate in this survey in advance. You may be sure that the information you will provide us is of the utmost important for the conservation of the environment and sustainable production in [COUNTRY].

Q04. Do you have enough information to answer questions related to agricultural practices in the holding?
Filter question. If the answer is No, stop the survey and find another respondent who is able to answer the questions. Once another respondent is found, read again the “TEXT TO READ” above and ask Q04 again.

If the answer is Yes, go to Q05.

The objective of this question is to provide the enumerator with information that will allow him or her to assess whether the selected respondent is the ideal person to answer questions related to the practices implemented in the farm.

If necessary, give the respondent further details on the subjects and questions included in the survey. In this way, you can assess whether it is necessary to find another respondent before continuing with the survey.

Q05. Record the following information about the respondent.
This section aims to collect relevant information about the respondent. If you have reached this question, it means that you were able to identify a respondent who knows about the practices implemented on the farm and who has confirmed that he or she is able to answer the questions included in the survey.
In Q05a, please select, from the list provided, what is the function of the respondent on the agricultural holding.

1. **Holder**, the person who owns the holding (legal documentation of the holding in its name) or who is economically responsible for the holding at the moment of survey application. For example, a farmer renting land, even though he or she may not be the legal owner of the land at the moment of survey application, is economically responsible for that holding and is in charge of making decisions related to production activities conducted within that holding. Please remember that the purpose of this survey is to collect information related to crop and livestock productions; it is not our purpose to determine who owns the land BUT rather what practices are been implemented to that land.

2. **Co-holder**, a second person who is considered an owner of the holding. This person should either legally own the holding or be economically responsible for the holding at the moment of the survey.

3. **Manager**, the person in charge of performing or supervising the day-to-day decisions on the holding operations. He or she does not legally own the holding and is not the primary person taking decisions on holding operation.

4. **Employee or household member**, a person who is either paid or a member of the household, works on the holding, and is able to respond, being knowledgeable about practices implemented.

5. **Household member not working on the holding**.

6. **Other (specify:____________)**.

In Q05b, c, and d, complete with first name, surname and sex of the respondent. In Q05e, f, g and h, complete with respondent’s complete address (including street, village and/or town, county and province), house telephone number, cell phone number and e-mail address, if available.

When obtaining respondent personal information (5b, c, d, e, f, g and h) make sure that none of the questions remains unsolved. If the respondent does not have a house telephone number or cell phone, the space corresponding to these answers must be filled with zeroes (for example, 0000-0000). If the respondent does not have an e-mail address, the space corresponding to this answer must be filled with the code NA, meaning “not applicable”, “not available” or “no answer”.

**SUBSECTION 1.2. IDENTIFICATION OF THE HOLDING**

**Q06. What is the legal status of the holder?**
Knowing the legal status of the holding is important to identify the context in which management decisions are taken.
If the legal status of the holding corresponds to a civil or natural person (option 1 in Q06) or to a group of civil or natural persons (option 2 in Q06) go to Q07, but only if respondent is not the holder or co-holder (see Q05). If the legal status of the holding corresponds to a legal person, skip question Q06 and go to Q08.

**Q07. Record the following information about the holder or co-holder only if person in Q3 is not the holder or co-holder.**

In Q07a, b, c, d, e, and f, complete with the holder’s or co-holder’s first name(s), surname(s), sex, address (including street, village and/or town, county and province); record the main telephone number at which the holder or co-holder can be reached, and include an e-mail address if available. If the respondent does not have a house telephone number or cell phone, the space corresponding to these answers must be filled with zeros (for example, 0000-0000). If the respondent does not have an e-mail address, the space corresponding to this answer must be filled with the code NA.

**Q08. Name of the holding**

Provide the name of the holding: either its complete legal name (if available) or the name used by the holder to identify the holding.

The legal name of the holding corresponds to the “name” used for legal purposes (for example, the name used on property documentation).

**Q09. Address of the holding**

Complete ONLY if the address of the holding is different from the address of the holder.

The address of the holder could be recorded in Q05e, if the respondent is the holder or co-holder; or in Q07d if the respondent is not the holder or co-holder. If the address of the holding is the same as that of the holder or co-holder, go to Q10.

**Q10. Georeferencing of the holding**

In Q10a and Q10b, please record the exact location of the holding by providing latitude and longitude coordinates in degrees, minutes and seconds.

Latitude and longitude coordinates can be taken (1) using a GPS unit previously set to the format of degrees, minutes and seconds; (2) using the GPS included in the Android tablets used when implementing the digital version of the survey; or (3) using a cellphone application to capture these coordinates. In the last case,
we recommend using the AndroïTS GPS Test Pro application. If a GPS unit is used, before recording the information, make sure that the GPS has good satellite coverage (a good satellite coverage reduces errors while retrieving coordinates). We must ensure that errors in holding location are minimized because we must extract additional information from each holding related to the landscape elements surrounding it, as well as variables related to location such as altitude, average temperature ($T^\circ$) and average rainfall.

To obtain an accurate recording of the holding location, the enumerator must take two readings, one at the main entrance of the holding (the enumerator must stand in front of the main entrance of the holding with the GPS unit) and a second reading in the middle of the holding’s main plot used (the enumerator must stand in the middle of the holding’s main parcel used with the GPS unit). The holding’s main plot used must be identified by the respondent. When the farm is too large and obtaining the coordinates of the main plot is difficult, at least the coordinates of the main entrance must be recorded.

SUBSECTION 1.3. AGRICULTURAL ACTIVITY

**Q11. What is the holding’s main agricultural focus?**
The answer to this question must be based on the activity that generates the highest economic income, not on the time spent on such activity. For example, if both crop and livestock production are performed on the holding, but income from crop production is significantly higher than that from livestock production, select option “1: Crop production”.

If the answer to this question is “1 Crop production”, go to **Q12**.

If the answer to this question is “2 Livestock production”, go to **Q13**.

[Please keep in mind that, for the purposes of this survey, rabbits, poultry and insects are not considered part of livestock production.]

**Q12. What is the main cropping activity?**
The main cropping activity is the one providing the highest economic value.

If the holding has different types of crops, make sure that you ask the respondent to indicate the most important one. The enumerator MUST only select one category from the list provided.

**Q13. What is the main livestock activity?**
The main livestock activity is the one providing the highest economic value.
Rabbits, poultry and insects are not considered.

If the holding has different types of livestock, make sure that you ask the respondent to indicate the most important one. The enumerator MUST only select one category from the list provided.

SECTION 2. AGRICULTURAL PRODUCTION
This section aims to collect relevant information about the agricultural production conducted on the holding.

All questions MUST be answered considering the established reference period, which corresponds to the last twelve months prior to the moment of survey application. This means that answers should consider activities implemented on the holding in the last twelve months.

The enumerator MUST request that the respondent provide the following information, to the best of his or her knowledge.

Q14. What is the total holding area?
Annotate the area and unit of measurement used by the respondent in the corresponding box. The unit of measurement refers to the unit used by the respondent to answer this question and may be, for instance, hectares (ha), square meters (m²), or any other local unit the respondent may use (acres, manzanas, varas, etc.). MAKE SURE THAT YOU SPECIFY THE LOCAL UNIT BEING REPORTED.

Q15. Please indicate the area of the holding used for agricultural production and other land purposes.
Annotate the area in the same unit of measurement selected by the respondent in Q14. Enumerators must verify that the sum of the area of different land uses are the same as (at least approximately), but not larger than, the total area of the holding provided in Q14. Additionally, indicate to the respondent that if option 5 “Other land (e.g. unutilized, rocks, wetland, etc.)” is selected, the area must be of a considerable size (for example, if it is only a small water spring, then it should not be reported). Select all that apply.

It is recommended that the enumerator draw a sketch of the holding with the help of the respondent, in which the different reported land uses are indicated. This will greatly help the enumerators throughout the survey to guide the respondent, and the enumerator to better understand the distribution of crops and pastures within the holding.
Q16. Did you perform agricultural activities in land outside the farm (owned, rented, borrowed or communal land)?

The objective of this question is to collect information about other areas used by the holder for crop or livestock production, regardless of whether the holder owns the land.

In the case of plots that are outside the holding, the enumerator must only consider those located within the smallest geographical unit (plots that are located at large distances from one another are likely to require different management, as their overall conditions might be different).

16a. Please indicate the total area outside the holding where you performed agricultural activities.

Annotate the area in the same unit of measurement selected by the respondent in Q14 and Q15.

Q17. How many plots did you use for agricultural production?

The enumerator must ensure that the total number of plots reported here matches those reported in future questions related to plot level.

When the respondent reports several plots used for a single crop, the enumerator must ask the respondent if differences exist in the management of these plots. If respondent indicates that all plots are managed similarly (that is, in all of them, the same management practices are implemented), then the respondent can consider these plots as a single plot, this will facilitate data recording.

When the respondent reports two sows of the same crop in different seasons of the year and under different management (for example, due to environmental factors that vary from one season to another), the enumerator must report two plots. For example, the respondent reports that, during the reference period, potatoes were sown twice, once during the dry season and once during the rainy season, and that management varies between the first and second planting. In this case, the enumerator must report two plots of potatoes [potato 1 and potato 2] because management was different. Potato 1, grown during the dry season, required the application of irrigation, while potato 2, grown during the rainy season, did not need irrigation.


The utilized agricultural area (UAA) corresponds to temporary and permanent crops and grasslands, and temporary fallow.
Make sure that you include all plots under the responsibility of the holder, considering those within and outside (rented, borrowed, etc.) the holding visited.

Please start with the largest plot corresponding to the main crop.

The enumerator must pay attention when noting the plot ID and, throughout the survey, ensure that the ID matches other answers related to each particular plot.

For example, if the respondent mentions that the holding grows 20 ha of corn, the enumerator must ask whether these 20 ha are cultivated in the same plot or in several plots (divided into several plots that have a total area of 20 ha). In figure 1, these 20 ha are divided in two separate plots (plot 2 and 7). If the 20 ha are divided in two plots, and management is different between plots (as explained in Q17), the information per plot needs to be recorded, for example plot 2, corn, 12 ha; plot 7, corn, 8 ha and so on. Additionally, if the same plots were used later during the reference period to grow other crops as shown in figure 1 (corn and beans grown in the same plots at different times of the reference period), this information must be carefully recorded. The enumerator must be extremely careful with this type of information, as it is of utmost importance for identifying the use of crop rotation within the reference period.

Figure 1. Representation of a holding with different plots and land uses. Note that even though the area is the same, during the reference period, plot 2 and 7 were used to grow corn and beans, while the others remain the same.

The enumerator must report all cultivated crops, regardless of the quantity harvested (even if such quantity is zero). The enumerator will also need to confirm that the total sum of the area of all plots corresponds to the holding’s total UAA as reported in option 1 in Q15. Please note that if (during the reference period) two crops are grown in the same plot [as plots 2 and 7 in figure 1], the total UAA reported in Q18 will not match the total UAA area reported in Q15, because in Q18 the information provided must be disaggregated by crop and plot. Thus, for example, the area of plot 2 will be reported twice during the
reference period: once for corn and once for beans. Do not ask additional questions until you have clarified any issues with plot areas.

Q19. Did you raise livestock?
The objective of this question is to know whether livestock was raised in the holding during the reference year.
Remember that for this survey, rabbits, poultry and insects must not be considered.

GLOSSARY OF LAND TYPES

Holding area: the total extension of the holding including agricultural area (AA) and land dedicated to forest and other wooded land, buildings and farmyards, aquaculture, tracks and ponds.

Agricultural area (AA): the area already used for farming (UAA) or that could be brought back into cultivation using the resources normally available on an agricultural holding (unutilized agricultural area, NUAA). AA includes arable land, permanent pastures, permanent crops, kitchen gardens, unutilized agricultural area and special holding areas (such as mushrooms, other production areas). It excludes woodland, other land occupied by buildings, farmyards, tracks, ponds, etc.

Utilized agricultural area (UAA): the total area taken up by temporary crops, grasslands and fallow land, permanent grassland, permanent crops and kitchen gardens. Excludes unused agricultural lands, woodland, and land occupied by buildings, farmyard, tracks, ponds, scrub land, etc.

Arable land: land worked (ploughed or tilled) regularly, generally under a system of crop rotation (crop rotation is only considered when two crops of different botanical families are cultivated in the same lands). It includes temporary crops and pastures and land temporarily fallow.

Temporary crops: includes all areas of the holding used for crops with a growing cycle that lasts less than one year. Following national classification practices, this may include some crops that remain in the fields after harvest for more than one year, such as strawberries, pineapples, bananas and cassava. It excludes temporary grassland. The area refers to the physical area of land, regardless of the number of harvests on the same land during the reference period. This category is broken down in the survey into two subcategories:

- Temporary crops under greenhouses or high shelters (permanent installations that can be entered); and
Temporary crops outdoors or under low shelters (non-permanent installations covering only the crop).

Temporary fallow: refers to arable land in rest before recultivation. The rest may result from crop rotation or other reasons, such as the fact that crops cannot be planted because of flood damage, lack of water, unavailability of inputs, or other reasons (WCA 2020, chapter 8). Usually, the temporary fallow land is left to recover for one year, and in some cases for approximately two years. Fallow land is not to be confused with permanent grassland or unutilized agricultural area (where the period of non-utilization is usually longer than three years).

Permanent crops: ligneous crops, meaning trees or shrubs, with a growing cycle longer than one year, which are not grown in rotation but occupying the soil and yielding harvests for several (usually more than five) consecutive years. The category includes land under trees and shrubs producing flowers (rose, jasmine, etc.), and nurseries of fruit trees. It excludes nurseries for forest trees and permanent grassland. The area refers to the physical area of the land, regardless of the number of harvests on the same land during the reference period. In the survey, this category is broken down into two subcategories:

- Permanent crops under greenhouses or high shelters (permanent installations that can be entered); and
- Permanent crops outdoors or under low shelters (non-permanent installations covering only the crop).

Grassland, meadows and pastures are divided into two categories:

- Permanent grassland: land used permanently (for several – usually more than five – consecutive years) to grow herbaceous forage crops, through cultivation (sown) or naturally (self-seeded), and not included in the crop rotation scheme on the agricultural holding. Permanent grassland refers to areas where the meadow grows without sowing for five years or more. In some countries, this type of pasture usually falls outside the area of the holding (for example, common pastures), and are used only by the holding. However, when the holding has an agreement for the exclusive use of a given area of permanent pasture, this area should be included as part as the holding’s UAA. Permanent grassland can be used for grazing by livestock or mown for hay, silage (stocking in a silo) or used for renewable energy production.
- Temporary grassland: pasture that is sown every one, two, three or four years.
Kitchen gardens: the area devoted to the cultivation of agricultural products intended exclusively for own consumption by the holder or manager and his family. Crops in kitchen gardens will not be detailed on a crop-by-crop basis.

SECTION 3. PRODUCTION PRACTICES

SUBSECTION 3.1 SOIL MANAGEMENT
Collecting information about soil management practices will provide insights on health, conservation and degradation of soils.

TILLAGE PRACTICES
The objective is to estimate the share of total UAA under conventional tillage, conservation tillage and zero tillage, also known as direct sowing.

Tillage practices include different activities performed to prepare soils for plant growing, usually grouped into two broad categories: (1) preparatory cultivation and (2) after cultivation. Tillage practices modify soil structure through a wide range of actions, which may include cutting, lifting, turning over, beating and partly pulverizing soil particles.

Q20. Did you implement tillage?
Filter question. If the answer is No, go to Q21. If the answer is Yes, go to Q20a.

Q20a. Tillage type
To obtain the total area under different tillage methods, the respondent is asked to indicate the tillage method used in each agricultural plot (temporary crops and temporary grasslands). Temporary fallow must be included if tillage was applied after harvest and within the reference period. Please remember that the purpose of this question is to obtain information about practices regularly implemented on soils.

Be aware that plot ID might appear twice if two crops with different types of tillage were cultivated in the same plot as part of a rotation system (figure 1). Crop names might also repeat if cultivated in two or more separate plots (figure 1).

Before asking the respondent to answer, the enumerator must provide a short description of each tillage category so that the respondent fully understands the differences between the categories:

Conventional tillage involves heavy disturbing of the soil (turning over) over the whole area considered. This type of tillage practice is usually applied using tillage tools or equipment such as a mouldboard or disc plough, or powered
tillage equipment such as a rotavator. It can also be carried out with traditional ploughs made of wood or iron and drawn by animal power.

**Conservation (low) tillage** involves practices of disturbing soils but usually leaving plant residues (at least 30 to 35 percent) on the soil surface, for erosion control and moisture conservation. Normally, soil should not be turned over but only ripped. This type of tillage might include the following systems, and the item definition should refer to those that are present in the country:

- **Reduced or minimum tillage** is a practice that is used in soil conservation to limit erosion. The equipment, such as a ripper, does not turn over the soils and causes little compaction, but does leave some ripping lines. For this reason, the soil retains a good cover of residues on the surface.

- **Strip tillage**, in which strips are tilled to receive the seed, while the soil along the intervening bands is not disturbed and remains covered with residues, such as mulch.

- **Ridge tillage** is a system of ridges and furrows. The ridges may be narrow or wide, and the furrows can be parallel to the contour lines or constructed with a slight slope, depending on whether the objective is to conserve moisture or to drain excess moisture. The surface is prepared by scraping off the top of a ridge, with the crops planted into the tops of the ridges formed during the cultivation of the previous crop. The soil is covered with residues between the rows until planting.

Be aware that conservation or minimum tillage can be performed with machinery or by hand, and is basically that tillage that affects areas where seeds will be planted. As such, its impact is minor.

**No tillage** or direct sowing does not include any formal tillage operations – the soil is most of the time covered by either plant residues or some kind of soil cover. The seeding operation is carried out with direct seeders that are able to open a narrow slot of the soil through soil cover.

Be aware that if the respondent reports permanent crops, the enumerator must ask if these were established during the reference period (twelve months prior to the survey application). If permanent crops were established during the reference period, the enumerator must ask about tillage practices implemented in the land in which permanent crops were established.

If no tillage is applied, the answer to Q20 must be **No**, and the enumerator should move on to Q21.
Figure 2. Types of tillage practices. A. Conventional tillage. B. Conservation tillage. C. No tillage or direct sowing.

**USE OF PROTECTIVE SOIL COVER**
The objective is to estimate the share of the year and area of the total agricultural area covered by plants (crops, cover crops) or plant residues.

**Q21. Did you use protective soil cover?**
Filter question. If answer is **No**, go to Q22. If answer is **Yes**, go to Q21a.

If the answer is **No**, the areas that are ploughed or otherwise tilled after the harvest are not sown or covered with any plant residues, remaining bare [bare soil] during the intercropping period.

**Q21a. Protective soil cover type**
To obtain the total area where protective soil cover was applied as well as the type of soil covered utilized, the respondent is asked to indicate the use and type of protective soil cover per plot (temporary crops and temporary grasslands). Include temporary fallow land if the soil was covered during the reference period.

The enumerator MUST provide the respondent with a short description of what is considered a protective soil cover for the purpose of this survey. Accurate description is very important for respondents to fully understand the differences between categories of soil cover type:

**Plant residues**: land covered with residues and stubble from the last crop season.

**Cover or intermediate crop**: area on which plants are sown specifically to reduce the loss of soil, nutrients and plant protection products during the intercropping period. Normally, they are ploughed in before the next sowing and are not harvested.

**Next seasonal crop**: this crop is sowed immediately after the last harvest.
**Plant residues and cover crop:** areas where both techniques are implemented. Farmers leave plant residues after harvest and also incorporate plants, to protect soils during intercropping periods.

**Figure 3. Types of protective soil cover.**

A. Bare soil  B. Plant residues  C. Intercropping  D. Cover crop.

If the farmer does not plow the field after harvest, then the plant residues remaining should be considered a protective soil cover. If the farmer plows the field after harvest, then it is considered that no protective soil cover is left, unless cover crops are established as shown in figure 3D.

The enumerator should ask the respondent to indicate, to the best of his or her knowledge, an estimation of the amount of time (time of permanence) that each protective soil cover type has remained on top of soils. This information will allow us to estimate the actual amount of time soils were protected. The enumerator MUST carefully record in the “Time unit” column the units in which the farmer answers the estimated time of permanence of protective soil cover (days, weeks or months).
AGRICULTURAL BURNING
The objective is to estimate the share of total agricultural area subjected to burning practices.

The use of agricultural burning refers to the use of fire at any point in time for crop cultivation. It consists of the burning in the open of vegetative materials from the production and harvesting of crops and animals for the purpose of marketing for profit or providing a livelihood. This practice is generally used to reduce crop residue, stimulate yield, control diseases, reduce unwanted plant species, maintain the productivity of agricultural lands (USDA 1999) or simply responding to farmers cultural reasons.

Q22. Did you implement agricultural burning?
Filter question. If the answer is No, go to Q23. If the answer is Yes, go to Q22a.

Q22a. Reasons for implementing burning.
To obtain the total burnt area during the reference period, the respondent is asked if each plot corresponding to different crop types, land temporary fallow, unutilized agricultural or wooded area has been burned. This is a non-excluding question and more than one reason for the implementation of burning can be selected. The enumerator should select all reasons that apply. If the respondent mentions a reason that has not been considered in the survey, please indicate it in the “Other (specify)” column.

Figure 4. Agricultural burning. A. Burning of residues. B. Burning of sugar cane fields.

OTHER SOIL EROSION MITIGATION PRACTICES
The objective is to estimate the share of total UAA under soil erosion mitigation practices or practices that allow for control of soil erosion.

Erosion mitigation practices involve the implementation of measures aiming to stop or slow down erosion processes, and includes protecting the soil surface
from rainfall negative effects, increasing water infiltration, decreasing runoff (speed and force), intercepting transported soil, and utilizing land in ways that help prevent or reduce the risk of erosion.

**Q23. Did you implement any other soil erosion control practices?**
Filter question. If the answer is **No**, go to Q24. If the answer is **Yes**, go to Q23a.

**Q23a. Please select the soil erosion control practices implemented.**
To obtain the total area where soil erosion mitigation practices were implemented during the reference period, the respondent is asked to indicate which soil erosion mitigation practices were implemented in each plot. This is a non-excluding question and more than one practice per plot can be selected. Please select all that apply.

Before asking the respondent to answer, the enumerator MUST provide a short description of different measures that are considered soil erosion mitigation practices. An accurate description is very important, as it allows the respondent to fully understand the differences between each measure and can identify the presence of either one or more soil erosion control practices:

- **Agronomic practices:** measures undertaken within the cropping area for primarily crop production purposes. These include practices such as intercropping, contour cultivation, minimum tillage and mulching (mulching means covering soils with a layer of loose material such as compost, manure, straw, dry grass, leaves or crop residues). Agronomic measures are usually associated with annual crops and do not lead to changes in slope profile.

- **Vegetative practices:** these involve the planting of trees, shrubs, grasses or others to form retention areas of natural vegetation (such as reforestation, contour hedgerows, natural vegetation strips, and live fences). Vegetative measures are long in duration.

- **Structural practices:** these involve the construction of physical structures such as terraces (bench, diversion, contour bunds, steep backslope or other terraces), diversions, drop structures and culverts, storage dams, levees and bank protectors. These measures lead to a change in slope profile and are long in duration or permanent.

- **Management practices:** these relate to management decisions taken with the intention of protecting land from erosion and improving production, such as land use changes and area closures. Soil erosion mitigation practices related to management involve a fundamental change in land use, which often results in
improved vegetative cover and a reduction in the intensity of use (such as the implementation of crops with trees, also known as agroforestry systems).

Q24. Over the last five years, did you notice loss of soil by washing or wind blowing from your farm?
Select only one option from the list of options provided.

Q25. Over the last five years, did you notice a reduction in the fertility of your soil (production is reducing, and/or you have had to abandon part of your land because it is no longer productive?)
Select only one option from the list of options provided.

Q26. Over the last five years, did you notice excessive accumulation of water on part of your holding that affects production (production is reducing, and/or you have had to abandon part of your land because it is not any more productive)
Select only one option from the list of options provided.

Q27. Over the last five years, did you notice accumulation of salt on the surface of your soil which affects its productivity (production is reducing, and/or you have had to abandon part of your land because it is no longer productive)
Select only one option from the list of options provided.

SUBSECTION 3.2. IRRIGATION
The final objective is to determine irrigation use, its consequences on the environment, and relevant water conservation practices. Questions in this section will enable measuring irrigable area (areas that, if required, can be irrigated as irrigation equipment is already in place), irrigated crops and areas, irrigation methods and source of water used for irrigation, as well as determine the use of water conservation practices within the holding.

The objective is to estimate the share of irrigable and irrigated area of total UAA.

Collecting information about irrigation use in agriculture is relevant to problems of water scarcity, particularly in regions with low rainfall (arid and semi-arid areas), high population density or intensive agricultural or industrial activity. Efficient agricultural water use is necessary to prevent seasonal water shortages and to sustain agricultural production.

Before asking the respondent to answer, the enumerator MUST explain what irrigation is.

Irrigation is “any process through which water is moved from a water source and applied to an agricultural crop” (FAO, 2015, para 8.3.2).
Following the explanation of what irrigation is, the enumerator MUST explain to respondent what “fully controlled irrigation” is. **Fully controlled irrigation** refers to the following methods:

- **Surface irrigation (furrow, border strip and basin):** one of the oldest methods of irrigating and refers to a system for partially or completely covering land with water for the purpose of irrigation. Farmers flow water down small trenches that run through their crops.
- **Sprinkler irrigation:** a method of applying irrigation water that simulates rainfall. Water is distributed under pressure through a system of pipes, usually by pumping. It is then sprayed into the air over the entire soil surface through spray heads, so that it breaks up into small water drops that fall to the ground.
- **Drip irrigation:** form of irrigation that saves water and fertilizer by allowing water to drip slowly to the roots of many different plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing and emitters.
- **Spray or microsprinkler:** microsprinklers and sprayers operate at low pressure and are designed for areas where drip irrigation is not advisable, for keeping plant foliage constantly moist, or when overhead watering is required. Microsprinklers and microsprayers are rated by flow rate, wetting diameter and spray method (moving parts for microsprinklers versus non-moving parts for sprayers).
- **Bubbler irrigation:** a localized, low-pressure, solid permanent installation system used mainly in tree groves. Each tree has a round or square basin that is flooded with water during irrigation. The water infiltrates into the soil and wets the root zone. The water is applied through bubblers, which are small emitters placed in the basins.

Q28. Did you have agricultural area with fully controlled irrigation equipment?
Filter question. If the answer is No, go to Q31. If the answer is Yes, go to Q28a.
Q28a. Report on the agricultural area that was equipped with fully control irrigation equipment, the area that was actually irrigated, and the main irrigation type used. Please indicate the frequency of irrigation and the season during which it was irrigated.

Irrigable agricultural area refers to all potential agricultural area that can be irrigated (irrigation equipment is in place and can be put to function at any moment), even if it was not irrigated during the reference period. Irrigated agricultural area refers to all of the agricultural area that was actually irrigated at least once during the reference period.

To obtain the total irrigable area for the reference period, the respondent is asked to indicate the area equipped with fully controlled irrigation and the type of irrigation equipment per agricultural plot (figure 6). When a plot has more than one irrigation technology, the enumerator should record that, covering the higher percentage of the plot area. Only one type of irrigation equipment per plot can be selected.

To obtain the total irrigated area, the respondent is asked to indicate the area that was actually irrigated with fully control irrigation methods (irrigated area), the frequency of irrigation (how often was the plot irrigated) and the growing season (rainy, dry) when irrigation had to be implemented.

The enumerator MUST explain to the respondent what is meant by irrigation use on the holding. “Irrigation used on the holding” means that water (other than rain) was applied to crops at least once during the entire reference period.

Q29. Identify the sources of water that were used for irrigation and indicate their importance in relation to the entire irrigated area.

To estimate the use of freshwater resources, the respondent is asked to indicate the source(s) of water used for irrigation purposes, the growing season when it was used, and the importance (in the form of the percentages used from each source for irrigation during the reference period) that each water source had relative to the total irrigation applied during the reference period. The enumerator MUST ask respondent to select all categories that apply (figure 7).
Q30. **Comparing the reference period with the past five years, do you consider that water available for irrigation is:**

To obtain an estimation of the state of water resources for irrigation, the respondent is asked to state whether water availability for irrigation (to his or her knowledge) has increased, decreased or remains the same. It should be noted that only one option can be selected as an answer.

### SUBSECTION 3.3 FERTILIZERS

This section aims to estimate fertilizer use and its consequences for the environment. Questions included in this section will allow for estimation of use or non-use, quantities applied (including the corresponding unit of measure) per agricultural plot (plot ID) and per crop, as well as the motivations for the application of fertilizers (chemicals and manure). This section will also allow for estimation of how frequent the use of manure as a fertilizer option is across holdings.

The objective is to estimate the amount of chemical fertilizers (nitrogen – N, phosphorus – P, potassium – K) used per area of agricultural land.
Before asking the respondent to answer, the enumerator MUST explain the concept of chemical fertilizer being considered for the purpose of this survey. A chemical fertilizer is an inorganic substance, primarily salts, containing nutrients required by plants – N, P, K or any combination of those three elements. The term includes simple mineral fertilizers (such as urea, ammonium nitrate and sulfate), complex mineral fertilizers (such as NP, NK, and NPK mixtures), and mineral-organic fertilizers (such as calcium cyanamid).

Q31. Were chemical fertilizers applied?
Filter question. If the answer is No, go to Q32. If the answer is Yes, the enumerator MUST ask the respondent for the corresponding information that will allow for each column of the table provided in this section to be filled. For example, the enumerator MUST ask respondent whether NPK, NP, PK or NK compounds were used on the holding per plot and to what crop or grass type. The enumerator must indicate to the respondent that when fertilizers were applied during land preparation, these amounts must also be reported. That is, all applications must be reported. The enumerator must make sure to ask the respondent about fertilizer applications at different stages of the production cycle (we are interested in all applications performed, pre- and post-harvest). Along with the type of compound, the enumerator MUST ask the respondent to provide an estimation of the amount used (quantity) per unit of area.

The quantity of fertilizers should be reported in unit by area. For example, pounds, kilograms or litres per hectare (lb/ha, kg/ha, lt/ha). The enumerator must select the measure reported by the respondent from the available list of units by area or choose “other” if reported unit by the respondent is not available on the list. In this case, the enumerator MUST specify what the respondent means by “other” and specify. The enumerator MUST carefully record the unit of measure.

If the respondent provides an approximation of applied quantity using a non-standardized measure, the enumerator must ask the respondent to further explain the methods of application (such as the type of container used to measure quantity and frequency, or the number of times that this measure was applied), to be able to estimate total quantity applied.
Example of how to calculate the quantity of fertilizer applied per unit of area.
A respondent reports that he grows potatoes in a 4 ha plot. In this plot he also reports the application of N fertilizer. Specifically, he reports that during the potato planting cycle [which corresponds to 6 months] he made 3 applications and that in each application he used 60 kg.

To calculate the applied quantity by unit of area, we must multiply the three applications by the amount used in each application, that is, 3 x 60 kg= 180 kg. This data must be divided by the plot area (4 ha) to obtain the kilogram per hectare (kg/ha) data.

That is, 180 kg ÷ 4 ha = 45 kg/ha. This value of 45 kg/ha is what we must report in the survey (quantity = 45, unit = kg/ha). Enumerator MUST be careful when calculating amount per unit of area.

Finally, if the respondent does not know the amount of fertilizer applied, the enumerator must write a zero in the “quantity” column and NA in the column “unit”. None of the columns can be left empty.

Table 1. N, P and K content in different compounds typically used in agricultural production.

<table>
<thead>
<tr>
<th>Compound fertilizers</th>
<th>Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPK fertilizers</td>
<td>15% N, 15% P₂O₅ and 15% K₂O</td>
</tr>
<tr>
<td>Diammonium phosphate</td>
<td>18% N and 46% P₂O₅</td>
</tr>
<tr>
<td>Monoammonium phosphate</td>
<td>11% N and 52% P₂O₅</td>
</tr>
<tr>
<td>Other NP compounds</td>
<td>20% N and 20% P₂O₅</td>
</tr>
<tr>
<td>Potassium nitrate</td>
<td>13% N and 46% K₂O</td>
</tr>
<tr>
<td>Other NK compounds</td>
<td>20% N and 20% K₂O P</td>
</tr>
<tr>
<td>K compounds</td>
<td>20% P₂O₅ and 20% K₂O</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Straight nitrogenous fertilizers</th>
<th>Nutrients</th>
<th>Straight phosphatic fertilizers</th>
<th>Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>46% N</td>
<td>Phosphate rock</td>
<td>30% P₂O₅</td>
</tr>
<tr>
<td>Ammonium sulphate</td>
<td>21% N</td>
<td>Superphosphates above 35%</td>
<td>46% P₂O₅</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>33.5% N</td>
<td>Superphosphates, other</td>
<td>20% P₂O₅</td>
</tr>
<tr>
<td>Calcium ammonium nitrate and other mixtures with calcium carbonate</td>
<td>26% N</td>
<td>Other phosphatic fertilizers, n.e.c.</td>
<td>20% P₂O₅</td>
</tr>
<tr>
<td>Sodium nitrate</td>
<td>16% N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea and ammonium nitrate solutions</td>
<td>32%</td>
<td>Potassium chloride (muriate of potash)</td>
<td>60% K₂O</td>
</tr>
<tr>
<td>N Ammonia, anhydrous</td>
<td>82% N</td>
<td>Potassium sulphate (sulphate of potash)</td>
<td>50% K₂O</td>
</tr>
<tr>
<td>Other nitrogenous fertilizers, n.e.c.</td>
<td>20% N</td>
<td>Other potassic fertilizers, n.e.c.</td>
<td>20% K₂O</td>
</tr>
</tbody>
</table>

Q32. Was manure applied?
If the answer is No, go to Q34. If the answer is Yes, the enumerator should keep in mind that manure can be applied in different forms (figure 8). The enumerator should make sure that the respondent understands that Q32 refers to any form of
manure application (solid or liquid) for the purpose of fertilizing crops or grasses.

**Figure 8. Different forms of manure application. A and B. Solid application. C. Liquid application.**

Q33. **Was the application of chemical fertilizers based on any of the following reasons?**
To obtain information about the rationale behind chemical fertilizer application, the enumerator MUST ask the respondent to provide a reason or reasons for chemical fertilizer application on the holding. It must be noted that the respondent may have more than one reason for applying chemical fertilizers; the enumerator MUST make sure that all applicable reasons are selected from the list provided.

**SUBSECTION 3.4 PESTICIDES**
This section aims to estimate pesticide use and its consequences for the environment. The questions included in this section will allow for estimation of use or non-use, the quantities applied (including the corresponding unit of measure) per agricultural plot (plot ID) and per crop, as well as the reasons for the application of fertilizers (chemicals and manure).

Before asking the respondent to answer, the enumerator must explain what pesticides are. It is possible that respondent is not familiar with the term “pesticide”, but does recognize what an insecticide or fungicide is. The enumerator must be sure that the respondent understands the question being asked. It is recommended to explain in a simple language that with the term “pesticide”, we refer to any substance used to control plant and animals pests and diseases.

For the purpose of this survey, a pesticide is any substance or mix of substances used to prevent, destroy or control any pest that damages or interferes in any way with production of agricultural products. The term includes substances or mixes of substances applied to crops before or after harvesting to protect the product. The pesticide term covers (1) fungicides; (2) herbicides; (3) insecticides; and (4)
other plant protection products (acaricides, bactericides, molluscicides, nematicides, rodenticides, etc.). It excludes biocides and disinfectant products.

(1) **Fungicides** are substances that destroy or inhibit the growth of fungi.

(2) **Herbicides** are substances used to destroy or inhibit the growth of plants (such as weeds) and mosses. Includes haulm destructors and moss killers.

(3) **Insecticides** are substances used to kill or repel insects.

(4) **Other**, acaricides are substances used specifically to kill or repel acarus. Bactericides are substances that destroy or inhibit the growth of bacteria. Molluscicides are substances specifically used to kill, repel or control mollusks. Nematicides are substances used specifically to kill or repel nematodes. Rodenticides are substances specifically used to kill, repel or control rodents.

**Q34. Were chemical pesticides applied?**

Filter question. If the answer is **No**, go to **Q36**. If the answer is **Yes**, the enumerator MUST ask the respondent for the corresponding information, that will enable filling in each column of the table provided in this section. For example, the enumerator MUST ask the respondent whether fungicides were used on the holding during the reference period. If the answer is positive, the respondent must also provide an estimation of the amount used (quantity) per unit of area and to provide the corresponding units of measure per plot and to what crop or grass type, as well as to indicate the type of label of the fungicide applied (for example, red, yellow, green). Additionally, the enumerator must indicate to the respondent that when pesticides are applied during land preparation, these amounts must also be reported. That is, all applications must be reported. The enumerator must make sure to ask the respondent about pesticide application at different stages of the production cycle (we are interested in all applications performed, pre- and post-harvest). The respondent may forget some applications, such as those performed to control ants. The enumerator must mention this type of situations to help the respondent remember all applications performed during the reference period.

The quantity of pesticides should be reported in unit by area, such as pounds, kilograms or litres per hectare (lb/ha, kg/ha, lt/ha). The enumerator must select the measure reported by the respondent from the available list of units by area, or choose “other” if the unit reported by the respondent is not available on the list. In this case, the enumerator MUST specify what the respondent means by “other” and specify. The enumerator MUST carefully record the unit of measure.

If the respondent provides an approximation of applied quantity using a non-standardized measure, the enumerator must ask the respondent to further explain...
the methods (for example, the type of container used to measure quantity and frequency of application to be able to estimate total quantity applied). See the example provided on p. 31 of this manual to calculate the quantity per unit of area.

When the respondent reports the use of a mix of pesticides in a single application, the most toxic pesticide must be reported (for example, if the respondent mixed green- and red-label pesticides, the red-label pesticide must be reported).

When the respondent does not know the amount of pesticide applied, the enumerator must write zero in the “quantity” column and NA in the column “unit”. None of the columns may remain empty.

Q35. Was the application of chemical pesticides based on any of the following reasons?
To obtain information about the rationale behind chemical pesticide application, the enumerator MUST ask the respondent to provide a reason or reasons for chemical pesticide application on the holding. It should be noted that the respondent may have more than one reason for chemical pesticide application; the enumerator MUST make sure that all applicable reasons have been selected from the list provided.

SECTION 4. PRODUCTION PRACTICES
The aim of this section is to collect information about other management practices commonly applied in agricultural holdings and the potential impact of these practices on the environment.

SUBSECTION 4.1. INTEGRATED PEST MANAGEMENT (IPM)
The objective is to estimate the share of total UAA under Integrated Pest Management (IPM).

Before asking the respondent to answer, the enumerator MUST explain what IPM is. The respondent may not be familiar with the concept of IPM. The enumerator can then proceed to explain, in simple language, that IPM refers to a set of actions that can be implemented in the farm to decrease the use of toxic substances and improve farm management in a holistic way.

For the purposes of this survey, IPM refers to a pest control approach that emphasizes the growth of healthy crops with the least possible disruption to the agro-ecosystem, and encourages natural pest control mechanisms. In IPM, preventing or suppressing damaging populations of pests relies on the implementation of a set of management and control practices based on
information on the life cycles of pests and their interaction with the environment. This information is used to manage pest damage through the most economical means, and with the least possible hazard to people, property and the environment. It allows for the judicious use of chemical pesticides after other less risky pest control methods are no longer effective or available.

Q36. Which of the following practices did you implement?
The enumerator MUST ask the respondent to select, from the list provided, all practices implemented in the holding with the purpose of diminishing the impact of pests. Select all options that were implemented during the reference period.

(1) **Monitoring actions** refers to the actions of monitoring pest presence or absence with the purpose of conducting timely interventions. For example, the enumerator could ask the respondent whether they keep track of pests’ appearance on the holding, increases or decreases in pests, whether they keep detailed records, etc.

(2) **Prevention crop cultivation methods** refers to the implementation of crop rotation (figure 1), intercropping (figure 5A), use of pest-resistant cultivars, hand weeding (or removal of material that allow proliferation of certain pests. For instance, the removal of remaining coffee fruits after the harvest lowers coffee berry borer infestation rates in the following growing season).

(3) **Low-risk methods as a first option for pest control** refers to the use of alternative practices, such as organic compounds or pest specific chemicals, before applying broad chemical compounds.

(4) **Appropriate handling, storage and disposal of pesticides** refers to the proper handling and final disposal of hazardous material, such as pesticide containers.

(5) **Use or design of a pesticide management plan based on records of previous pesticide application outcomes** refers to the use of previous lessons regarding the application of pesticide. How does the respondent decide when, how and how much pesticide needs to be applied? Do they have any kind of application plan?

Q36a. Provide a reason for the implementation of the selected practice
The enumerator MUST ask the respondent to provide the main reason for the implementation or non-implementation of each of the actions described above (1-5). Select the main reason from the list provided. Please select all reasons that apply, as farmers might have multiple reasons for the implementation of IPM. If the respondent provides a reason that it is not included in the list provided, select option 6, “Other” and specify (write down) the reason given by the respondent.
SUBSECTION 4.2 CROP ROTATION
The objective is to learn about crop rotation implementation beyond the reference period established for this survey. This information is important to assess the impact of agricultural land uses on biodiversity (such as wild animals and plants) persisting in agricultural landscapes. The implementation of a rotation scheme will provide different types of habitats for wild species of importance for crop production, such as pollinators and those providing pest control services.

Keep in mind that for the purpose of this survey, crop rotation is only considered when two crops of different botanical families are cultivated in the same land at different times (figure 1).

It is important that the enumerator differentiate between “crop rotation” and “associated crop”. Crop rotation implies that a crop was planted and harvested, and then a second crop was planted and harvested within the same plot but at different times. Crop association implies that two crops grow in the same crop at the same time.

Q37. Was crop rotation implemented for a period longer than the reference period?
If No, go to Q38.

SUBSECTION 4.3 ENERGY FROM RENEWABLE SOURCES
Because agriculture is a major contributor to global warming through the emissions of greenhouse gases (GHG), the objective is to estimate the production and use of renewable energy in the holding as an alternative to fossil fuel energy. Only the energy that is produced within the holding and utilized for actions related with agricultural production is of interest.

Questions in this section will provide a basis for estimating the generation and use of energy produced from solar, wind, water, biomass and other sources.

Energy is an essential input for the production of food. Increasing food production while improving the efficiency of energy use is one of the main challenges of modern agriculture, where demand for food production increases as a consequence of human population growth and changing food consumption patterns.

Monitoring energy use within the agricultural sector is a crucial element in achieving sustainable agricultural production. Efficient energy use is a key factor in sustainable farming, as it is related to the responsible use of natural resources
and to reductions in GHG emissions (Sims et al., 2015). The latter is of utmost importance because, as mentioned above, agriculture is a major contributor to global warming through the emissions of GHGs.

The use of renewable energy sources constitutes an opportunity for the agricultural sector to decrease its reliance on fossil fuels. Renewable energy sources include solar, wind, hydropower, etc.

Before asking the respondent to answer, the enumerator must provide the respondent with a short description of different energy types produced from renewable sources.

(1) **Wind**: the use of wind to dry agricultural products, or transport water or produce electricity through windmills.

(2) **Water**: the use of water force to generate electricity through micro-hydropower generators or water mills.

(3) **Solar**: the use of energy from the sun to directly dry agricultural products or generate electricity through solar panels.

(4) **Biofuel/biodiesel**: the use of plant products to produce fuels for machinery and transportation.

(5) **Biogas**: the use of manure to produce biogas through digesters or biogas reactors. Biogas is a mix of methane, carbon dioxide and other trace gases that can be converted to heat, electricity or light.

(6) **Other**: the respondent is asked to specify other activities for which selected renewable energy is used in the holding for agricultural activities (for example, charcoal and wood fuel).

**Q38. Was energy from renewable sources produced within the holding?**
Filter question. If the answer is **No**, go to **Q39**. If the answer is **Yes**, go to **Q38a**.

**Q38a. Identify which types of energy from renewable sources were produced within the holding and used for activities related to agricultural production.**

The enumerator must indicate that the respondent must select all types of energy from renewable sources that is produced within the holding during the reference year and that was utilized for the implementation of agricultural activities. Only energy that is produced within the boundaries of the holding is of interest. Additionally, the enumerator must ask the respondent to indicate what activities are performed using the energy produced. The enumerator must omit uses that do not correspond to agricultural activities (such as domestic use). Please select all types of energy and all types of use that apply from the list provided. If the “other” category is selected, specify (write down) what the respondent means by “other”.

103
Figure 9. Different types of renewable sources for energy production. A. Wind mills. B. Water mills. C. Solar panels, in this case used for water pumping. D. Biodigester used for biogas production.

SUBSECTION 4.4 GENERATION AND MANAGEMENT OF SOLID WASTE

that is derived from crop production.

Before asking the respondent to answer, the enumerator must provide the respondent with a short description of what solid waste is.

Solid waste covers discarded materials that are no longer required by the owner or user. Solid waste includes materials that are in a solid or liquid state but excludes wastewater and small particulate matter released into the atmosphere. Solid waste includes all materials sent to or collected by waste collection or treatment schemes, including landfill establishments. Solid waste also includes those same materials if they are discarded directly in the environment, whether legally or illegally. For the purposes of this survey, solid waste from agricultural production includes:

(1) Non-functioning vehicles (tractors, agricultural machinery) – any vehicle that is no longer used but remains within the holding.
(2) **Used tires** – usually from non-functioning vehicles remaining within the holding.

(3) **Waste oils** – any deposit or containers containing oils no longer in use or usable.

(4) **Empty packaging of pesticide products** – any empty pesticide container.

(5) **Empty packaging of fertilizer products** – any empty fertilizer container.

(6) **Empty packaging of diesel, gasoline or other petroleum products** – any empty package or container used for storing or transporting diesel, gasoline or other petroleum products (such as kerosene).

(7) **Empty packaging of cleaning and disinfection products** – any empty package or container used for storing or transporting cleaning and disinfection products.

(8) **Empty packaging of seeds (bags and containers of all sizes and materials)**

(9) **Used plastic film** – for instance, plastic film used for crop or soil protection.

(10) **Ropes and nets (used for forage conditioning or viticulture)**

(11) **Pesticides that are no longer usable**

(12) **Veterinary waste** – residues from veterinary-related activities (medicine plastic containers, syringe, etc.)

(13) **Dead animals** – specifically, livestock animals that have died due to disease or injury.

**Q39. Identify which types of solid waste were generated by the agricultural activity and the final treatment.**

The numerator MUST ask the respondent to identify what types of solid waste were generated by the holding and the treatment given to each waste type. Please select all types of waste and all treatments that apply from the list provided.
SUBSECTION 4.5. GENERATION AND MANAGEMENT OF WASTEWATER
The objective is to collect information about how the holding manages wastewater produced on the holding.

Before asking the respondent to answer, the enumerator MUST provide the respondent with a short description of what wastewater is.

Wastewater constitutes any water that has been used (in household activities such as washing dishes, or in a productive process such as milking, etc.)

Q40. Was wastewater generated by the holding?
Filter question. If the answer is No, go to Q41. If the answer is Yes, go to Q40a.

Q40a. Identify the wastewater generated by the holding and the final treatment.
The enumerator MUST ask the respondent to identify what types of wastewater were generated by the holding and the treatment given to each wastewater type. Please select all types of waste and all treatments that apply from the list provided.
(1) **Discharged to a constructed retention or holding pond** – any water that, after having been utilized, is discharged into a constructed structure that serves as a retention or holding pond.

(2) **Discharged to a septic or sewer system** – any water that, after having been utilized, is discharged into a formal septic or sewer system.

(3) **Discharged into a vegetative filter strip or constructed wetland** – any water that, after having been utilized, is discharged into an area with vegetation or into an artificial wetland.

(4) **Applied to agricultural land** – any water that, after having been utilized, is used to water agricultural land.

(5) **Included in the liquid manure system** – any water that, after having been utilized, is used to liquefy manure.

(6) **Not managed, removed through natural drainage** – any water that, after having been utilized, is simply discharged outside the area where it was utilized, with no additional treatment or use.

---

**Figure 11. Use of water in agricultural holdings.** A. Wastewater being disposed directly into a river. B. Washing of coffee on a humid mill. C. Cleaning of milking facilities.

---

**SUBSECTION 4.6. WATER CONSERVATION PRACTICES**

The objective is to know if the holding is or is not implementing water conservation practices.

Before asking the respondent to answer, the enumerator MUST provide the respondent with a short description of what water conservation practices are. Water conservation practices are a set of practices directly related to water management and indirectly related to soil management, that are associated with water saving in agricultural production.

**Q41. Did you implement any type of water conservation practices?**

Filter question. If the answer is No, go to Q42. If the answer is Yes, go to Q41a.
Q41a. Please indicate implemented water conservation practices.

To know whether the holding has implemented water conservation practices during the reference period, the respondent is asked to indicate if any of the following practices were used: (1) Modification of agricultural practices; (2) improving irrigation efficiency; (3) reusing wastewater; (4) reduction of transportation losses; and (5) rainwater harvesting. This is a non-excluding question and more than one practice per plot can be selected.

The enumerator MUST provide the respondent with a short description of the different water conservation practices:

(1) **Modification of agricultural practices** – careful crop selection, together with soil moisture conservation, can all reduce crop water use. Practices included here are mulching and tillage to break pore continuity and reduce water evaporation from soils, use of vegetative cover to protect soils from moisture loss due to evaporation, and breeding and selection of crop species and varieties that are adapted to the local climate and to make efficient use of water.

(2) **Improving irrigation efficiency** – the improvement of the percentage of abstracted water that is delivered to the field (conveyance efficiency), and the improvement of the ratio between the water used by a crop and the total amount of water delivered to that crop, which indicates how well an irrigation system performs in transporting water to the plant roots (field application efficiency). Such practices include the use of efficient irrigation technologies (such as localized fully controlled irrigation), as well as the use of soil moisture and rainfall sensors to optimize irrigation schedules.

(3) **Reduction of transportation losses** – in many developing countries, the transportation of water during the dry season might be the only way to provide crops with the necessary water supply. Reduction in the losses due to transportation are a necessary practice to reduce water consumption. Such practices include transportation of water in containers that are in good shape and do not leak.

(4) **Rainwater harvesting** – water harvesting is a technique of developing surface water resources that can be used in dry regions to provide water for livestock, for domestic use, and for agroforestry and small-scale subsistence farming.

(5) **Reuse of wastewater for irrigation** – in areas where water is scarce, treated wastewater provides an alternative source of water for irrigating crops.
SUBSECTION 4.7. LANDSCAPE HABITAT ELEMENTS
The objective is to know if the holding is or is not implementing landscape habitat elements related to higher biodiversity levels, such as hedges, live fences, shade trees or dispersed trees (such as agroforestry systems and dispersed trees in pastures), forest plantations, home gardens, secondary forest patches, mature forest patches, riparian forests, and windbreaks.

Q42. Identify which of the following landscape habitat elements were present in the holding. Please provide the best area estimations you can, ONLY for non-linear habitats.
The respondent is asked to select those landscape habitat elements that were present in the holding during the reference period (figure 12) and to provide estimations of areas for elements such as home gardens, tree plantations, secondary forests and mature forests.

Figure 12. Landscape elements commonly present in agricultural holdings.

SECTION 5. LIVESTOCK PRODUCTION
TEXT TO READ:
This section of the survey is about the livestock under the responsibility of the holder in plots outside and inside the holding. Report for all animals regardless of ownership, including those that are boarded (animals in pension), owned by another member of the household, custom-fed or fed under contract. Rabbits, poultry and insects are not considered.
Q43. **Report the type of livestock raised during the reference period.**
This a non-exclusive question. The respondent must select all livestock types raised in the holding. The enumerator must ask the respondent to provide the number of animals present and their purpose, whether they were raised for meat, dairy or double purposes.

Q44. **Please provide the total area dedicated to livestock.**
The enumerator must ask the respondent to provide the total area of the holding that is dedicated to livestock production (area estimation must include all areas used for livestock production). Remember to indicate the unit of measure reported by the respondent.

Q45. **What percentage of area dedicated to livestock corresponds to steep slopes (> 30º)?**
The enumerator must ask the respondent to provide the best estimate he or she can of the total area dedicated to livestock that has a slope greater than 30º (30 degrees in inclination).

**SUBSECTION 5.1. ROTATIONAL GRAZING PATTERNS**
The objective is to estimate the share of total agricultural area under a rotational grazing scheme.

Q46. **Did you implement rotational grazing on your agricultural land?**
Filter question. If the answer is No, go to Q47. If the answer is Yes, go to Q46a.

Before asking the respondent to answer, the enumerator MUST provide the respondent with a short description of what rotational grazing is.

Rotational grazing is the practice of moving grazing livestock between pastures (often called paddocks) as needed or on a regular basis. The implementation of rotational grazing implies moving livestock between paddocks every set number of days (figure 13). Movement of animals allow soils to rest and slows or stop potential compaction processes.
Q46a. Could you indicate the average resting period?
The enumerator must ask the respondent to indicate the best estimate he or she can provide of the average time during which the paddocks are empty (without animals). Make sure to provide the unit of time in days, weeks or months.

46b. Indicate the number of plots in which you rotate the livestock.
The enumerator must ask the respondent to indicate the number of paddocks that are included in his or her rotation scheme.

SUBSECTION 5.2. LIVESTOCK WATERING

Q47. Identify which sources of water were used for watering livestock. Indicate if the water source was used or not across all seasons and its importance in relation to the entire use of animal watering in the holding.

To estimate the state of water resources, the respondent is asked to indicate the source(s) of water used for watering animals, the season when selected water sources were used (figure 7), and its importance in relation to the entire use of animal watering in the holding.

The enumerator must indicate that the respondent must select all types of water sources used (1) on-farm ground water (borehole or well); (2) on-farm surface water; (3) off-farm surface water (lakes, rivers, watercourses); (4) off-farm municipal water supply or other water networks; (5) rainwater harvesting; and (6) other. If the respondent chooses “Other”, please specify.
Q48. Comparing the reference period with the past five years, do you consider that water availability for watering animals is:
To estimate the state of water resources for watering animals, the respondent is asked to answer if water availability for watering animals is (1) more abundant; (2) scarcer; (3) the same; (4) of the respondent does not know.

Q49. Do animals have free access to natural watering sources (creeks, streams, rivers, water springs, etc.)?
To evaluate potential issues with animals accessing water sources used for human consumption. The enumerator MUST ask the respondent to state whether holding animals have free access to watering sources.

END OF THE SURVEY
The enumerator MUST state his or her name again and provide the time and data on which the survey was finalized.

The enumerator MUST thank the respondent once again and assure him or her that his or her answers are extremely valuable for the work we are conducting.

THANK YOU VERY MUCH for your time and patience.