Local-level appraisal of benefits and barriers affecting adoption of climate-smart agricultural practices: Curití, Colombia

Technical report for the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

March, 2014

Caitlin A. Peterson
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SUMMARY
Although Climate-Smart Agricultural (CSA) practices are expected to boost adaptive capacity, food security and climate change mitigation in resource poor, smallholder farming systems, the barriers that can restrict its uptake are diverse. This study investigated the barriers hindering CSA practice adoption in the Santander department of Colombia as well as farmer perceptions of practice benefits and disadvantages. A questionnaire survey of 30 households in Macaregua village, Curití municipality, in addition to focus group discussions and in-depth, semi-structured interviews revealed that non-adoption was most often a result of insufficient financial capital, water scarcity, lack of technical knowledge or the inappropriateness of the practice for management system or physical environment. Women and men farmers reported essentially equal levels of awareness of CSA practices and similar perceptions as to benefits and disadvantages. The author noted rainwater harvesting/storage, improved crop varieties, composting, conservation tillage, low-cost biodigesters and organic pest control as practices with high potential for further CCAFS investigation and/or on-farm participatory trials.
INTRODUCTION and OBJECTIVES
The combination of projected world population growth and changing human diets will have far-reaching effects on food production systems. The challenge of increasing production 70% to feed the world’s population in 2050 is made all the more difficult by climate change and its negative impacts on agricultural production (Lobell et al. 2008) and food security (Schmidhuber and Tubiello 2007) in hunger-prone areas of the global tropics.

The widespread uptake of practices and technologies that are conscious of these impacts is of primary importance to increase the adaptive capacity of farming systems and mitigate agriculture’s contribution to global greenhouse gas emissions. Climate-smart agriculture (CSA) is a concept intended to address the need for climate consciousness in agriculture while not placing undue burdens on the resource poor small farmers who are often the most vulnerable to climate impacts.

As defined by the Food and Agriculture Organization of the United Nations, CSA is agriculture that “sustainably increases productivity and resilience (adaptation), reduces or removes GHGs (mitigation), and enhances achievement of national food security and development goals” (FAO 2010). At the local level, CSA can be conceived as a suite of practices – ideally ones that have been assessed for local suitability – that can improve a farmer’s adaptation to changes in climate or increase the mitigation potential of production through carbon sequestration or reduced emissions, while still meeting or exceeding food security goals. At the national or regional level, CSA is more often considered a conceptual framework that examines the tradeoffs between the three “pillars” of adaptation, mitigation and food security.

Determinants and barriers for CSA adoption
For CSA to have the desired impact on the resilience of agricultural systems it must be applied across a multitude of geographical, social, economic and political contexts. However, for farming communities within each of these contexts the obstacles that impede or complicate CSA adoption are different. Therefore, local-level assessments are necessary to first confirm the suitability of target practices and subsequently to determine how their widespread adoption might best be facilitated.

Case studies from both the developed and developing world point to common variables that affect the likelihood that an individual farmer will adopt sustainable practices. For example, the scale of the farming operation, the farmer’s age, gender, wealth, membership in agricultural organizations, land tenure status, and education level all have an influence on practice adoption (Smithers and Smit 1989; Deressa et al. 2008). Adoption rates also hinge on subjective variables such as farmers’ awareness of new practices, personal willingness to adopt them, and overall concern for the problem the practice aims to address (Below et al. 2010). These variables are themselves contingent on pre-existing worldviews on relevant actions, institutions, and information sources, among others (Koltko-Rivera 2004).

Indeed, even when conditions favor the adoption of the target practices, farm level or technology-specific barriers such as inappropriate soil types or difficult-to-acquire material inputs can cause additional hindrances. Commonly reported barriers to the adoption of
sustainable agricultural practices, including those that fall under the CSA framework, are financial constraints and shortages of labor, land or water (Deressa et al. 2008), as well as lack of necessary transportation assets or low farmer organization membership (Ibrahim et al. 2012). Farmers may be generally willing to adopt new practices, but perceive a specific practice to be inadequate, unnecessary, or difficult to incorporate into existing management systems (Smithers and Smit 1989).

Widespread CSA adoption also depends on factors of social differentiation, most notable age, gender, and diversity. Women and men farmers, for example, may not access, use or benefit from practices in the same way (see Archer, 2003). The same may be true of farmers with different income and education levels, family size, land tenure status, religious beliefs, place of birth, or relationship to institutions and individuals in power. These factors must be considered when analyzing appropriateness of CSA practices as well as barriers to their adoption.

Likewise, the degree of institutional support in an area will affect whether CSA practices – especially those requiring more substantial startup investments or technical knowledge – can be adopted easily. Institutional investment in agricultural communities (infrastructure, extension services, health care) will affect farmers’ ability to absorb risk and, in turn, adopt new practices (Below et al. 2010). Legal and political frameworks also influence adoption rates. For example, policy on informal seed fairs and genetic resources can affect farmers’ ability to save seed of locally tolerant crop varieties or access improved varieties through exchange with other farmers (Progressio 2009). Thus, technological, social, economic, and institutional factors all play a role in whether target CSA practices can or will be adopted, both within farming communities and on the national and regional scales.

**Objectives**

West Africa, East Africa and Latin America are regions of interest for the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). These regions are characterized by severe projected climate impacts and a large proportion of their populations relying on agriculture for their livelihoods. This research made an appraisal of the benefits and barriers to adoption of CSA practices in three countries: Ghana, Colombia and Tanzania. Despite the distinctiveness of each location, the anticipation was that complementarities, lessons or ideas may be observed that could be translated between contexts to facilitate the widespread adoption of appropriate CSA practices.

The objective was to identify the current extent of CSA adoption at sites in these regions, with an emphasis on the barriers that may be preventing its widespread uptake. Questions to be addressed were:

- What practices are currently being utilized in the area of interest, and how do farmers perceive their benefits and disadvantages?
- Why are practices that are seen as desirable or beneficial not currently being utilized?
- What gender differentiation factors exist relating to the perception of benefits, disadvantages, and overall desirability of each practice?
Foundational CCAFS research has already been carried out at the selected research sites in Ghana, Colombia and Tanzania. This work includes the CCAFS Baseline Household Surveys, which provided 1) corroboration for some findings, 2) pre-existing household lists for selection of participants at each site, and 3) data for additional comparative analyses (see Kristjanson et al. 2012; Naab et al. 2011). Additional participatory and survey-based CCAFS research is ongoing in Ghana (see Naab and Koranteng 2012) and Tanzania (see Shikuku et al. n.d.). CCAFS’ Latin America program is still incipient, although the Baseline Surveys were carried out in sites in Colombia by researchers from Bioversity International in 2012 and the data was available for the above purposes.

The overall objectives of this study were as follows:

1. Inventory local CSA practices currently in use in each site;
2. Summarize barriers and constraints to CSA adoption from the farmers’ perspective (both in qualitative and quantitative forms), including how gender differentiation could impact adoption/non-adoption;
3. Make recommendations to CCAFS and partners as to promising avenues for further research, especially with regard to CSA practices that show potential for beneficial impact and widespread farm-level adoption.

METHODS
Latin America has been identified as a core region of interest for CCAFS. The region was selected due to its large rural populations that depend on rain-fed, cereal based subsistence farming for their livelihoods. These populations are highly vulnerable to climate variability and extreme climate events (see description of region selection for CGIAR Challenge Programs in Förch et al., 2013).

Climate change in Colombia is expected to have far reaching impacts on over 3.5 million people, 14% of the national GDP corresponding to agriculture and 80% of crops (Ramirez-Villegas et al. 2012). Soil degradation and erosion, flooding in coastal regions, losses in habitat suitability for high-value export crops such as coffee and heightened vulnerability for resource poor smallholders are also anticipated (Ramirez-Villegas et al. 2012).

Study Area
The municipality of Curití in the department of Santander is located in the northeastern Andean mountain ranges of Colombia. It is the country’s principal bean-producing region, though it is also a major producer of tobacco, maize, coffee and sisal. The livestock sector is less developed with around 6,000 head of cattle and a few minor livestock species such as pigs, goats and sheep. The northeastern Andes are one of the most climatically vulnerable regions in Colombia; soil erosion, increasing desertification and water scarcity are problematic (IAvH et al. 2010). Extreme climatic events such as the 2010-2011 La Niña phenomenon have affected large numbers of families in the area with flooding, infrastructural damage and crop loss (Castañeda Duarte 2012).
Macaregua village was chosen as host for this study due to the availability of CCAFS baseline survey data for households there in addition to recommendations from key informants and considerations of size and research fatigue or community members. Members of Macaregua village are also participating in Bioversity International research on climate vulnerability and adaptation, as part of the conservation work of Fundación Conserva in Curití municipality ongoing since 2010.

**Literature Review and Verification**

A brief literature review of existing primary and grey literature on CSA work in Colombia was undertaken to gain an *ex ante* perspective of its manifestations in the country and particularly in the region of interest. Literature included reports in English and Spanish on specific practices or technologies, on-farm trials or participatory work being undertaken by organizations, NGOs and government ministries in the area. Searches were refined to the specific agro-ecological zone and crops of interest by using keyword combinations such as “bean,” “tobacco,” “Curití,” “San Gil,” “Santander,” “tobacco-bean/maize complex,” “tobacco-bean production system,” “Mc,” and “silt-loam.” These searches formed the basis for a rough list of CSA practices hypothetically appropriate for Curití.

The rough list was later verified and refined through consultation with on-site key informants who were able to speak to the context of the information gleaned from the literature review. These informants could identify practices that were clearly unsuitable for the Curití area or largely unknown, in addition to indicating potentially appropriate CSA practices that were not yet widely in use. Informants were selected based on their ability to give insights on CSA adoption in Curití from the institutional perspective, their familiarity with the municipality and village in question, and their knowledge of relevant climate change and agriculture related projects and research. They included representatives of guilds and research organizations, local community government leaders and researchers active in the municipality.

**Household Questionnaires and Semi-Structured Interviews**

CSA practices identified as locally appropriate, well-known and/or actively promoted in Curití municipality were incorporated into a questionnaire survey, semi-structured interviews, and focus group activities carried out in Macaregua village from 12-19 August, 2013.

**Community entry and sampling**

The community was introduced to the researcher, purpose of the project and activities to be carried out during a joint focus group activity with Bioversity International researchers already working in the area and thus well-known and trusted by community members. Prior to this meeting, permission was sought from the leader of the Community Action Board (the local government for villages in Curití municipality) to conduct further research in the village, in addition to the ongoing Bioversity International work. Local guides were assigned to assist the researcher with translation tasks and to further introduce the researcher and project goals to participants that had not attended the initial focus group.
Due to the small size of Macaregua village and the lack of a complete household list for randomized sampling, the same 30 households that had participated in the 2012 CCAFS Baseline Survey conducted by Bioversity International were questioned again for this survey. Households were informed that this questionnaire was a follow up to the questionnaire that they had answered a year ago. Households whose primary livelihood earning activity consisted of something other than agriculture were omitted from the survey and replaced by households recommended by the community guides.

One individual from each household participated in the paper questionnaire, and care was taken so that an equal number of both men and women farmers were questioned.

**Questionnaire design and administration**

Questionnaires were administered in Spanish with the assistance of picture cards representing CSA practices that served both to help define each practice and to aid respondent recall. The questionnaire format incorporated both close-ended, yes/no questions and open-ended questions that allowed more space for conversation and story-telling.

Questions were designed to take into account that CSA is a new term applied primarily at the institutional level; it is virtually unused in the rural populations being studied here. Although farmers may be aware of a particular agricultural practice, they may not necessarily associate it with CSA or even understand the concept’s definition in the same way as the researcher. Thus, the questionnaire made no explicit mention of CSA but rather focused on individual practices: Whether the farmer had heard of the practice, whether they use it on their land, what they saw as its benefits and/or drawbacks, and the social, economic, environmental, or other barriers that may be preventing them from adopting a practice that they consider beneficial.

Additionally, respondents were allowed to identify individuals in the village who were known to have adopted CSA practices or be particularly innovative. These individuals were sought out for additional interviews to generate more in-depth, qualitative information on perspectives of change in farming systems and climate and the challenges affecting productivity and sustainable innovations in Curití municipality.

See Appendix 1 for a copy of the complete questionnaire and appendix 2 for sample semi-structured interview guiding questions.

**Participatory focus groups**

Focus group sessions served as a qualitative complement to the questionnaire, giving community members a chance to self-analyze, present opinions, venture questions to fellow group members and share stories of successes and failures related to selected CSA practices.

Focus groups for this study were conducted jointly with a team from Bioversity International as part of a series of participatory activities being undertaken by that organization in Macaregua village. Men’s and women’s groups were held simultaneously and the activities were divided between two days and four groups of participants: two groups from the upper part of the village and two from the lower. Participants took part in 2-3 activities and accompanying
discussions for a total of 2-3 hours for each session. Group participation was strictly voluntary, meaning sampling was non-representative for the purposes of rapid assessment. This caveat should be taken into account when interpreting the results, especially considering that some marginalized groups may have been left out of the conversation.

An institutional mapping activity asked participants to reflect on the organization of their village and the institutional arrangements within and without. Group members were directed to first list all institutions, organizations, and formal and informal groups active in the community. They gave brief explanations of the purpose of each institution with special regard to agricultural activities, and indicated whether membership is male-only, female-only or mixed gender and whether the institution is internal (composed only of community members) or external (composed only of outsiders) to the community. Participants then assigned institutions a circle size depending on their relative importance (i.e. activeness in community, degree of positive impact, frequency of meetings or visits). Through the direction of the other participants, a group-elected representative arranged paper cut-outs of these circles to represent their relationship with a larger, empty circle representing the entire community and a central red circle representing the local community government organization or principle decision-making body.

Participants also constructed a seasonal livelihood strategies calendar indicating the times of the year during which aspects of different family livelihood earning strategies (e.g. cultivation of tobacco, beans, sisal; livestock rearing) are carried out, important climate events and their timing, and month-wise availability of food and money. Participants were also asked to indicate the most important crops in their area, the different varieties that are employed, and the benefits and disadvantages of each variety.

See appendix 3 for example focus group guiding questions.

**Analysis**

Results from the household questionnaires were summarized by descriptive statistics. A two-tailed Student’s t-test or two-tailed z-test for proportions were used where appropriate to determine gender differences in response frequency, type or diversity. Correlation analysis described the relationship between awareness of CSA practices and their overall adoption, and a Kruskal-Wallis “analysis of variance by ranks” non-parametric test indicated differences between adoption rates for users with different education levels or amounts of land available for agriculture. Qualitative analyses of focus group and interview results were used to complement results from the questionnaire and, in some cases to explain those results.

**RESULTS**

**CSA practices for Curití, Colombia**

The literature review and subsequent verification by informant interviews identified a total of 22 relevant CSA practices for Curití municipality (this list is not considered exhaustive). Table 1 lists these practices and their basic definitions. Qualifications or modifications are noted where
the definition may depend on site-specific considerations. Justification for each practice’s inclusion in the list is provided, i.e. its contribution to any or all of the three CSA “pillars”: climate change adaptation, GHG emissions mitigation, and food security. These justifications are based primarily on empirical evidence available from the scientific literature (key examples are listed in the “source” column) as well as interviews with farmers and informants in Curití (noted as “personal communications” in the “source” column).

In some cases, debate exists in the literature as to whether a practice can be considered climate-smart. Chemical fertilizers, for example, are GHG emissions producers and may be an unsustainable long-term adaptation measure due to negative impacts on soil quality. However, they were included in the list of CSA practices for Curití because farmers repeatedly indicated that they viewed them as an adaptation measure against declining soil fertility and shorter growing seasons, as well as an imperative for household food security. Practices such as chemical fertilizer use exemplify the nature of CSA trade-offs, and they are included with the aim of incorporating farmer opinion into analyses and better understanding the extent and pattern of their use.
Table 1. Agricultural practices included in “Barriers to CSA adoption” questionnaire and definitions as per the local context in Curití municipality, Santander, Colombia.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Definition</th>
<th>Justification for inclusion</th>
<th>Source</th>
</tr>
</thead>
</table>
| Agroforestry or silvopastoral systems         | Deliberate planting or protection from removal of more than one tree in the past 12 months either on agricultural land, its borders, or land set aside specifically for tree planting purposes; incorporation of trees and forest habitats in pasture and forage systems | **Adaptation**: sustained soil fertility; creation of favorable microclimates; reduced moisture stress  
**Mitigation**: soil erosion prevention; soil carbon sequestration; carbon sequestration from perennial plant biomass  
**Food security**: tree products and environmental services | (Verchot et al. 2007)  
(Callo-Concha et al. 2002)                                                                 |
| Biodigestor, biogas                           | Apparatus often made of cement or black plastic consisting of a tank where livestock manure and/or crop residues are collected and broken down by anaerobic digestion to produce methane gas. The gas is then used for fuel and energy purposes | **Mitigation**: Replacement of firewood or propane as fuel sources; replacement of synthetic fertilizers with bioslurry; capture of methane emissions from raw manure  
**Food security**: Reduced expenses for fertilizers and fuel; improved productivity from use of bioslurry | (Cornejo and Wilkie 2010)                                                                                   |
| Chemical fertilizers                         | A substance of synthetic origin that is applied to the soil to supply one or more key nutrients for plant growth and crop yield. Colombia soils do not experience a high degree of nitrogen deficiency, but farmers in Curití consider nitrogen fertilizers a critical adaptation to declining soil fertility. Nevertheless, mitigation potential would depend on increasing the efficiency of nitrogen use. | **Adaptation**: compensation for declining soil fertility  
**Food security**: Farmer emphasis on crop failure when fertilizer use omitted | (Palm et al. 2010)  
(Personal communications)                                                                                   |
| Composting, vermiculture, organic fertilizers | Collection and heaping of organic waste materials such as food scraps, crop residues or livestock manure in a pit, pile or other structure to allow for decomposition and later application to cropland soil. Vermiculture involves use of earthworms to speed the decomposition process. | **Adaptation**: compensation for declining soil fertility; lower input requirements  
**Mitigation**: emissions reduction from avoiding application of raw animal manure; soil structure improvement/erosion prevention  
**Food security**: improved productivity | (Niggli et al. 2009)  
(Leon Moreno and Coronado Silva n.d.)                                                                   |
| Contour planting                              | Planting crops in lines across the contour of a slope, rather than along the slope, to improve water retention and prevent soil erosion and landslides.                                                      | **Mitigation**: soil carbon sequestration; erosion prevention  
**Food security**: improved productivity on marginal land and steep slopes | (Altieri 1999)  
(Quinton and Catt 2004)                                                                                   |
| **Crop rotation** | Systematic movement of crop plots year after year to avoid the exhaustion of soil nutrients through continuous use by the same type of crop. Included either unconscious use—the farmer switches crops when s/he notices yields declining on a particular plot—or conscious use—the farmer purposefully chooses to alternate crops that will replenish the nutrients depleted by the other, for example planting groundnuts after maize. | **Adaptation:** improved pest/disease tolerance  
**Mitigation:** erosion prevention; soil structure improvement  
**Food security:** productivity maintenance through avoidance of soil exhaustion | (Adiku et al. 2009)  
(Stringer et al. 2009) |
| **Efficient stoves** | Can be built-in brick structures with cast iron planks and oven for cooking, as well as a chimney, or small iron or steel structures designed to contain heat, increase the temperature of the flame and thus reduce the amount of wood fuel necessary for cooking and heating. | **Mitigation:** increased combustion and fuel efficiency; reduced particulate air pollution; reduced non-renewable biomass harvesting  
**Food security:** reduced cooking time; reduced time spent acquiring fuel | (Johnson et al. 2009)  
(Pine et al. 2011) |
| **Greenhouse cultivation** | Cultivation of crops in a glass or clear plastic structure that prevents excessive evaporation and protects plants from heat or cold, allowing off-season planting. In the Santander region greenhouses are mostly constructed for the purposes of germination of tobacco seedlings before transplanting, and building materials are supplied by tobacco organizations. | **Adaptation:** crop protection from unpredictable rainfall, strong winds, drought; prevention of excessive evapotranspiration  
**Food security:** lengthened productive season; production and livelihood diversification | (Borsdorf et al. 2012)  
(Acosta Frances 2013) |
| **Home gardens** | Cultivation of vegetables and other food products in a dedicated plot near to the household primarily for the consumption of the family. | **Adaptation:** diversification of livelihood; risk-spreading  
**Food security:** reduced risk of food shortages from crop failure or lack of funds; small income gains or savings; improved availability of food sources during seasons of scarcity | (Krishnamurthy et al. 2002)  
(Personal communications) |
| **Improved forages** | Deliberate sowing of easily digested or high-protein forages on rangelands, including select undomesticated grass and legume species and genetically improved varieties. | **Adaptation:** restoration of degraded lands  
**Mitigation:** nitrogen fixation by leguminous fodders; reduced emissions from enteric fermentation of livestock through improved digestion  
**Food security:** healthier livestock; improved income from market price; availability of meat for household consumption | (Peters et al. 2013) |
| **Improved livestock breeding** | Genetic improvement of a herd or flock through targeted cross-breeding for specific traits, including pest/disease resistance, heat tolerance and overall productivity. | **Adaptation:** resistance to climate related stresses, pests, diseases  
**Mitigation:** herd reduction through improved quality of fewer total stock  
**Food security:** improved productivity/yield of milk/meat yield for household consumption; improved market price | (Gill et al. 2010)  
(FAO 2007) |
| --- | --- | --- | --- |
| **Improved crop varieties** | Use of genetically improved germplasm specifically bred for traits such as increased yield, stress tolerance and/or disease resistance. | **Adaptation:** stress tolerance and disease resistance; early maturing to avoid crop loss from shorter growing seasons or unreliable rains  
**Food security:** improved productivity; reduced risk of crop failure | (Below et al. 2010)  
(Branca et al. 2011) |
| **Intercropping** | Planting of two different, though complementary crops on the same plot of land, either in a mixed, row, or strip intercropping system. | **Adaptation:** reduced risk of total crop failure  
**Food security:** production diversification | (Laube et al. 2012)  
(Stringer et al. 2009) |
| **Irrigation technologies** | Transporting and supplying water to crops making use of labor saving or increased-efficiency technology, either on a large scale such as a canal/pump system, or as a smaller micro-irrigation scheme. | **Adaptation:** compensation for drought or reduced rainfall  
**Food security:** diversification of production through facilitating home gardens; reduced risk of crop loss | (Laube et al. 2012) |
| **Live fences** | A subcategory of agroforestry; Use of trees, hedges or multi-purpose plants as borders of pastures and croplands. Included in Colombia study due to potential use of sisal plants – already an established livelihood source in the communities. | **Mitigation:** carbon sequestration from perennial plant biomass; improved soil quality  
**Food security:** Improved productivity through modified microclimates and water conditions; additional livelihood source from sisal; improved fodder accessibility if perennial grasses used | (Albrecht and Kandji 2003)  
(Ellis-jones and Mason 1999) |
| **Minimal tillage** | Tillage refers to all methods used to prepare soil for planting, especially the loosening and breaking up of top soil by the use of a hoe, plow or similar tilling implement. In the Colombian context, minimal or conservation tillage usually refers to land preparation through slashing of existing vegetation, allowing for some re-growth and then application of a glyphosate-based herbicide, followed by hand seeding or seeding using a planting pick (vertical aeration) or direct-seeder. | **Adaptation:** reduced soil compaction from overtillage; prevention of soil degradation  
**Mitigation:** emissions reduction compared to deep tillage or conventional plowing; improved soil structure; erosion prevention  
**Food security:** Improved productivity; reduction of production costs | (Lal and Bruce 1999)  
(Leiva et al. 2002) |

**Barriers to CSA adoption: Colombia**
| Barriers to CSA adoption: Colombia | | Mitigation: reduced emissions associated with production/use of synthetic insecticides  
Food security: prevention of crop loss through improved access to pest control method for farmers without means to purchase chemicals | (Scialabba and Müller-Lindenlauf 2010)  
(Ziesemer 2007) |
|---|---|---|---|
| Organic pest management | Application of organic substances (especially chilli-based recipes in this region) to prevent or eliminate the occurrence of pests on crop leaves, roots and fruits both pre- and post-harvest. | Mitigation: avoidance of pasture degradation; soil carbon sequestration; protection against drought conditions  
Food security: improved pasture and livestock productivity; higher forage quality | (Delgado et al. 2011)  
(Eagle et al. 2012) |
| Pasture rotation | Use of electric wires and moveable posts to create temporary grazing areas for herds that can be moved to a different area once the fenced pasture is exhausted. | | |
| Residue management/Non-burning | Either leaving organic material left behind after harvest on soil surface to act as mulch or collecting it for composting and later application to fields -- often a combination of both depending on speed of decomposition and residue volume -- rather than burning. Usually refers to cereal crops, especially maize. | Adaptation: compensation for drought or low rainfall conditions through improved water retention; reduced soil temperature to prevent losses from higher air temps.  
Food security: improved productivity through higher soil quality | (Andreae and Merlet 2001)  
(Acharya et al. 1998) |
| Seed saving, local tolerant varieties | Traditional practice of guarding a portion of harvested seed for planting the next year, a form of conserving local agricultural biodiversity as well as gradually selecting for varieties tolerant towards local environmental conditions. | Adaptation: protection against climate vulnerability, pests, and diseases through genetic heterogeneity of landraces  
Food security: reduced costs for external inputs (seeds) | (Altieri and Merrick 1987) |
| Staggered planting | Elongating the planting period by planting a single crop in several different stages so that at any point in time each succession is at a different stage of development, and harvesting happens in a staggered timeframe. | Adaptation: reduced risk of crop loss from climate variability, extremes  
Food security: reduced post-harvest losses | (Valdivia and Quiroz 2003)  
(Personal communications) |
| Water storage | The collection and storage of large quantities of rainwater in plastic or concrete tanks, or improved concrete-lined lagoons or ponds. | Adaptation: water provision during drought or low rainfall conditions  
Food security: improved productivity or prevention of crop/livestock losses through irrigation, water hole availability | (Altieri and Koohafkan 2008) |
CSA Practice Adoption

Questionnaire results from Macaregua village (n=30, 57% men and 43% women) indicate that 70% or more of respondents were aware of all selected CSA practices (Table 2). Actual adoption rates, however, varied widely among practices regardless of farmer awareness. Adoption rates were highest for synthetic fertilizers (97% of households), seed saving and use of local crop varieties (90%), cultivation in greenhouses (77%) and intercropping (73%). Least adopted practices included biogas or biodigesters (0% of households), organic pest control (7%), and living fences (10%). Men and women respondents exhibited essentially equal levels of awareness for all CSA practices.

Table 2. Proportion of 30 surveyed households in Macaregua village, Santander, Colombia, aware of, currently using, or, if not currently using, willing to introduce CSA practices on their farms.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Aware of practice (%HHS)</th>
<th>Using practice (%HHS)</th>
<th>Willing to introduce practice (%HHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical fertilizers</td>
<td>97</td>
<td>97</td>
<td>N/A</td>
</tr>
<tr>
<td>Seed saving</td>
<td>100</td>
<td>90</td>
<td>33</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>100</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td>Intercropping</td>
<td>97</td>
<td>73</td>
<td>43</td>
</tr>
<tr>
<td>Composting</td>
<td>97</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>Improved crop varieties</td>
<td>93</td>
<td>70</td>
<td>71</td>
</tr>
<tr>
<td>Water storage</td>
<td>100</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>Contour planting</td>
<td>97</td>
<td>67</td>
<td>22</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>87</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Mulching, crop residues</td>
<td>80</td>
<td>53</td>
<td>50</td>
</tr>
<tr>
<td>Pasture rotation</td>
<td>97</td>
<td>53</td>
<td>46</td>
</tr>
<tr>
<td>Improved forages</td>
<td>93</td>
<td>50</td>
<td>46</td>
</tr>
<tr>
<td>Agroforestry, silvopastoralism</td>
<td>87</td>
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<td>Biodigester</td>
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n=30

Although awareness of a particular CSA practice is a prerequisite to its adoption, high awareness of a practice did not necessarily lead to high adoption rates (Figure 1). For example,
home gardens and efficient stoves were known to 100% of respondents, but only 23% of those households that were aware of the practice were also using it on their farms. Biodigesters also exhibited a large discrepancy between awareness (93% of households) and adoption (0% of households).

Figure 1. CSA practices with the largest and smallest discrepancies between proportion of households aware of practice and proportion actually using practice on the farm in Macaregua, Colombia.

Rates of practice adoption had no relationship to household education level ($t=-1.2, p=0.24$) or land available for agricultural purposes ($H=4.87, p=0.09$)

The practices most often cited by participants as the most important for getting a good harvest were: 1) intercropping (43% of responses), seed saving (37%), water storage (27%) and improved crop varieties (23%) (Table 3).

Table 3. CSA practices most often mentioned as a top 3 practice, i.e. those that the respondent considered most important for good production in Macaregua, Colombia.
Advantages and Disadvantages of CSA Practices

Perceived benefits of CSA practices were distributed across 14 principle responses; the top response made up only 20% of the total number of responses. The benefits most commonly perceived by both men and women were the reduction of agricultural inputs needed (usually money, fuel or water), higher crop or livestock yield and reduced risk of crop or livestock loss. Only male respondents mentioned reduced labor requirements and improved soil fertility/structure, while only women respondents mentioned human health and wellbeing and availability of forage or water for livestock.

![Perceived benefit of CSA practices](image)

**Figure 2.** Gender differences in perceived benefits of CSA practices from 30 households in Macaregua, Colombia. Men (n)=17; Women (n)=13. None of the differences were statistically significant (p<0.05).

The four most commonly perceived disadvantages to CSA practices by both men and women were: greater difficulties in acquiring inputs (cost or availability), greater labor requirements, probable failure or inappropriateness of the practice, and lack of knowledge needed to implement the practice.

The most often cited reason for abandoning a practice was water availability, mostly with reference to water storage and home gardening practices. Labor shortages were also noted, especially for home gardens and improved forages. Indeed, home gardens were the most commonly abandoned practice overall for these reasons.
According to questionnaire respondents, financial asset availability and water availability are the two factors most needing to change to facilitate the adoption of desirable CSA practices (Figure 3). More knowledge or information about the practices as well as changes in the type or quantity of agricultural land managed were also among the most commonly mentioned barriers to overcome. However, 16% responses for all practices indicated that no change was needed to adopt the practice, implying that a switch to a CSA practice required nothing more than the farmer’s own volition.

Respondents showed high overall interest in adopting new CSA practices, especially in the cases of water storage and irrigation technologies, composting, efficient stoves, and home gardens. Respondents were least interested in adoption conservation tillage methods, citing low productivity and poor overall system performance as reasons for their disinterest. Desire to introduce intercropping was also low among those that had not already adopted it due to concerns about poor performance and increased risk of crop loss. Farmers who had no desire to cultivate tobacco were uninterested in adopting greenhouses, as these were seen as tools strictly for tobacco germination and are usually built using resources provided by tobacco companies. Similarly, willingness to adopt contour planting depended on the type of land under management; farmers with slightly sloping or flat lands had no need for the practice.

Knowledge and institutional support
Questionnaire responses indicate that, in Macaregua, decisions related to agriculture are usually taken by men or jointly by spouses. Responsibility for carrying out agricultural labor also lies mostly with men or both men and women. No decisions or responsibilities are strictly the women’s, although observation evidence reveals that women are more involved in small livestock production than other agricultural activities.

Figure 3. Most commonly mentioned barriers to be overcome to adopt CSA practices to 30 households in Macaregua, Colombia. Participants could mention multiple barriers.
Information related to CSA practices comes from three main sources: family members, the farmer’s own experience and neighbors. Women were more likely than men to cite their own experience as their source of information on CSA practices ($z = -3.05, p < 0.01$) (Figure 4). Little to no mention was made of external sources such as government agencies, sector related organizations (such as guilds and farmers’ organizations for tobacco or cereal growers), radio or television.

Figure 4. Gender differences in most commonly cited information sources related to CSA practices for 30 households in Macaregua, Colombia.

Evidence from focus group institutional mapping activities also suggests scarce presence of institutions that provide technical support and advice on agricultural matters and that thus might serve as a source of information on CSA practices (Figure 5). The men’s institutional diagram includes some of the only examples of agriculture-related institutions that might be positioned to provide technical advice: the Farmers’ Syndicate, FENALCE (the Colombian cereal and bean growers guild that has undertaken several programs on reduction of post-harvest losses and related topics in the village), and UMATA (the Municipal Unit for Technical Agricultural Assistance). The latter is the equivalent of a public agricultural extension service, although it has been largely de-funded and currently conducts no activities in the Curití municipality. It was mentioned in the focus group in place of the organization currently filling that role in Curití whose name the participants could not remember.

The women’s diagram, although richer in detail than the men’s, provides fewer examples of agriculture-related institutions active in the area. Febetabaco and Protabaco – private companies that contract tobacco production in the area – are two exceptions, along with the Coffee Growers Federation and SENA, a technical training institute for rural community development. Women and men alike place greatest importance (as indicated by circle size) on development aid related institutions such as Families in Action and the Senior Citizens Group, and educational institutions like the primary and secondary schools and IDEAR (a technical institute offering high-school diploma opportunities to rural youth).
Most of the institutions listed during the mapping activity were either fully external to the community or only partly internal; apart from the Community Action Board no examples were noted of communal agricultural groups or organizations founded within the community itself and directed exclusively by community members.

Figure 5. Institutional Venn diagrams created by men and women’s focus group participants in Macaregua village, Colombia. The large, unnamed central circle represents the village, the red circle the local decision-making body, and gray circles the other institutions in the area. Positions of the grey circles represent the institutions’ relationship to the local government, the village, and each other.
DISCUSSION

Overall awareness of practices considered CSA or known to contribute to sustainable natural resources and land management is high among surveyed individuals in Macaregua; a majority of survey respondents were aware of the selected practices. As adoption is conditional on awareness, we can therefore assume that non-adoption is usually a result of factors other than unfamiliarity with the practice or concept.

Indeed, farmers that were both aware of and willing to adopt new CSA practices indicated that the main barriers to their introduction are the lack of financial assets (for biodigesters and efficient stoves) and water scarcity (for irrigation systems and home gardens). The need for more technical knowledge on the implementation of practices such as composting and organic pest control was also noted by participants. In some cases, practices were perceived as inappropriate for the amount or type of land being managed or likely to fail given environmental conditions in the area. For example, succession planting, conservation/minimal tillage and living fences were considered undesirable for these reasons.

In the case of water availability, 73% of the households in the community are fed by the municipal aqueduct (Bioversity International, unpublished data). Houses in the higher-altitude section of the community collect rainwater in open lagoons, or, in a few cases, plastic storage tanks fed by the roof of the house. Farmers indicated that collection of rainwater has been highly unreliable in recent years due to increased rainfall unpredictability and less overall rainfall compared to the past. Water from either of these sources is rarely sufficient for irrigation purposes although the lagoons do provide drinking water for livestock. Even for household purposes the water arriving from the aqueduct is often insufficient or turbid and only marginally suitable for human consumption.

The introduction of micro- or drip-irrigation systems may be a CSA option in the area despite these difficulties, as the amount of water they require would be minimal. Support of initiatives to construct improved lagoons and reservoirs that reduce water loss through absorption or evapotranspiration is another possibility to consider. Furthermore, increased use of rooftop rainwater harvesting systems such as those already in use in some households in the community could reduce pressure on scarce aqueduct resources and provide a second water source for home consumption or small-scale irrigation for household gardening in the event of water shortages in the municipality.

Macaregua has seen a trend of increasing agricultural commercialization over the years, with more households producing cash crops for sale than subsistence crops for home consumption. Farmers report that it is easier and more secure to buy food from off-farm than to rely on self-produced goods; many indicate this fact is a primary reason behind the abandonment of the home vegetable garden. Indeed, previous studies in the area have confirmed that over 90% of households source their food from off-farm during every month of the year (Bioversity International, unpublished data). This trend means that fewer and fewer crops are being grown primarily for household consumption, and that they are instead sold as a source of cash income.
It is interesting to note that households in a purely subsistence context seem just as likely to report lack of funds as a barrier to CSA adoption as households who have moved into this kind of small-scale commercialization. Financial solvency remains a problem even as physical cash flow into the home increases through moderate commercialization. While commercialization has brought much needed infrastralural improvements and social benefits to the area, it may in other respects have made farmers more vulnerable to unpredictable market fluctuations and stimulated a cycle of chronic indebtedness. Farmers reported that often the entirety of their earnings from the year’s harvest is directed towards outstanding debts, obliging them to take out further loans to be able to carry on with production for the next year.

The Agrarian Bank is virtually the only formal institution offering agricultural loan opportunities in Curití and surrounding districts. Farmers’ limited access to alternative financial institutions may contribute to the cycle of indebtedness reported by surveyed individuals. To diversify the loan market, savings and credit schemes led by farmers’ organizations could be a viable alternative to formal loans. Similar microfinancing initiatives should be considered to facilitate the introduction of desirable CSA practices with high start-up costs such as efficient wood stoves and biodigesters.

Indeed, biodigesters are an example of a practice that has seen successful implementation in other regions of Colombia and the rest of Latin America (Herrero n.d.; Cornejo and Wilkie 2010), but that requires funding and training support from higher level institutions. There is one example of a functioning, high-quality biodigester in Macaregua village, and its installation required considerable self-initiative and technical know-how from an individual who was a professional in construction. In this case, the individual drew up the building plans and contributed the manpower and location to test the structure, while a non-governmental tobacco farmers guild provided the approximately $3,000 USD needed for construction materials. Lower cost and less demanding models are available, but their implementation will require further investment and involvement from both public and private sector institutions.

Other CSA practices were indicated by farmers to be unsuitable for their land or management systems. These included living fences, which would impede the current system of pasture rotation using temporary electric fencing, succession planting, considered too risky given unpredictability in the timing of the rainy season, and conservation tillage using herbicides and vertical aeration. The latter practice was perceived to be less productive than deep tillage with a tractor and more labor intensive; its only potential benefits were that it could be used when conditions were too wet for use of the tractor and that it reduced production costs from hiring of farm equipment.

Although farmer priorities emphasized the need for heavy tillage, previous studies have indicated that even making fewer passes with the tractor can reduce problems associated with soil compaction and result in increased yield in beans and tobacco in Curití (Leon Moreno and Coronado Silva n.d.). Vertical tillage or direct seeding techniques could further alleviate compaction problems, but the practice requires increased on-farm testing and farmer socialization to demonstrate its benefits first-hand.
Farmers placed heavy emphasis on genetic resources as key to productivity, although views were conflicting as to the superiority of certain crop varieties over others. Some regions of Colombia are endowed with rich diversity in resilient indigenous crop varieties, and in these areas seed saving and the conservation of indigenous varieties has been of paramount importance (Acosta Frances 2013). Curití, however, is characterized by a relative paucity of crop genetic resources and varietal diversification has been further challenged by a fickle consumer market seeking product uniformity. Farmers have eagerly sought out improved hybrid varieties offering high yields in spite of drought and other environmental stressors. Nevertheless, some still prefer the local “creole” varieties, citing their resistance to pest damage while on the stalk (in the case of the local maize variety) and the increased cost of acquiring fresh hybrid seed every year.

Creole seeds are saved for replanting by a majority of households in Macaregua, but farmers who do not already save the local seed varieties show low interest in doing so. This result may indicate that local varieties are considered a risk and cost reducing option, but their decreasing productivity makes hybrid varieties more desirable. Trials of improved bean varieties are ongoing in Santander department (CIAT, in progress; Bioversity International, in progress) and continued emphasis should be placed on the testing and wide dissemination of new and improved varieties, especially of beans and maize.

The potential of CSA practices to reduce the amount of external agricultural inputs needed for production was the benefit most often mentioned by farmers. Seed saving to avoid the cost of purchasing hybrid seeds is one example of a practice offering this benefit; reduction of synthetic inputs such as fertilizers and pesticides through composting, vermiculture and the use of organic homemade pesticides is another. Almost every household in Macaregua uses chemical fertilizers, perceiving them as a prerequisite for even a modest harvest. This custom is a change from past years, however; farmers note that more fertile and productive soils as recently as 10 years ago made the use of chemical fertilizers unnecessary.

Although it could be argued that use of chemical fertilizers is thus an adaptation to increasing soil degradation from over-tillage and temperature stress, there is difficulty in qualifying it as CSA in this case. Nitrogen deficiency is not as severe a limitation on productivity in Curití as soil compaction and erosion or water scarcity (Municipio de Curiti 2006). In fact, over-application and inefficiency of nitrogen and synthetic pesticide regimens are more common problems, constituting negative climate impacts that make the practices unsustainable as adaptations.

A CORPOICA study in Curití found that combining chemical and organic fertilization could produce higher yields that chemical fertilization alone (Leon Moreno and Coronado Silva n.d.). However, farmers report that they lack technical training and information on alternatives like composting and vermiculture, and although some are skeptical as to the performance of organic pesticides in comparison to synthetics there is great interest in testing alternatives.

Special note should be made of agricultural gender roles when considering potential benefits or disadvantages from CSA adoption. Though women and men tend to share joint responsibility for agricultural decision-making, women mainly take responsibility for farm work close to the
home, e.g. cooking, raising chickens and goats and caring for children. They are less involved in other areas of farm work and consequently less likely to see direct benefits from many of the CSA practices described here.

The exceptions may be practices that decrease cooking time and reduce household fuel requirements. Efficient wood stoves and biodigesters are two such practices that both men and women farmers indicated were highly desirable, despite acknowledging difficulties related to their high start-up costs. Adoption of either of these two practices might have the additional effect of freeing up women’s time and labor that could be dedicated to other production activities, such as home vegetable gardening. In fact, many women reported a desire to reintroduce home gardens but that they are deterred partly by the extra demands on their time.

Considering farmers’ demand for increased technical knowledge relating to many CSA practices (composting, organic fertilizers and pesticides, biodigesters), institutional arrangements and information flow should be further examined in Curití. The Community Action Board is a highly accessible local institution in most communities and thus an ideal conduit for CSA research and initiatives. Additionally, the importance of membership in school and development organizations for women, and involvement with farmers’ syndicates and private sector companies for men, should be noted as potential pathways of agricultural information dissemination. The lack of internal community groups relating to agriculture in Macaregua village could reveal that the human capital available within the village itself is not being taken full advantage of, in preference for external sources of aid and training. Improved within-community organization could be another way to improve knowledge dissemination and self-reliance, considering the generally low level of external institutional involvement in the community.

CSA has been criticized for being too broad in the sense that virtually any practice that contributes to improved food security or more efficient resource use could be considered CSA, regardless of its implications for climate change mitigation (see Neufeldt et al., 2013). For the purposes of this study, practices considered CSA were restricted to those that enhance food security – normally in the form of improved productivity – while also including a considerable element of either adaptation or mitigation according to empirical evidence. That is, practices had to demonstrate a clear double-win for producers as well as the potential for additional benefits for either adaptation or mitigation. Exceptions to empirical justifications were noted when key informants at the site (or the farmers themselves) specified that a certain practice represented a strong adaptation or food security benefit to local farmers.

A technology or practice driven approach (rather than a systems level, political, or institutional approach, for example) was taken for this research with the reasoning that if desirable or easily adopted practices and surmountable barriers could be identified in each site, these could serve as points of departure for further CSA related development and research. The ex ante development of the practice list may have restricted the freedom of participants to suggest adaptive practices that had not been yet been taken into consideration, although this approach was meant to conserve some level of consistency in the identification of practices to be
considered CSA in accordance with the above concern.

CONCLUSIONS and RECOMMENDATIONS

This study was intended to serve as an entry point for further CCAFS work on CSA in the Curití area and the rest of Colombia. Farmers’ preference for practices that address crop genetic resources, alternatives to synthetic fertilizers and pesticides, and agricultural input reduction, as well as their concern for water scarcity and financial capital availability, must be factored into future planning and adaptation exercises. The potential of CSA practices such as water harvesting and micro-irrigation techniques, savings and credit schemes, organic fertilization and pest control, conservation tillage techniques and biodigesters/biogas to provide benefits to farmers should be noted, in conjunction with attempts to facilitate more extensive adoption of these techniques.

Next steps will include further participatory research at multiple governance levels to first prioritize CSA actions to be taken and later pilot initiatives with the involvement and evaluation of local stakeholders. Impact and vulnerability analyses and environmental modeling should also be a part of this process to further ensure the appropriateness of selected CSA practices for the site. The aim is for this sequence of diagnosis, prioritization and action to be repeated and improved upon in other CCAFS sites and regions for eventual widespread uptake and implementation of CSA techniques. Specific recommendations for CCAFS include:

1. Improve access to a diverse array of crop genetic material that is resilient to local environmental challenges.

Improved crop variety seeds are in high demand in Curití, thanks to the declining productivity of local “creole” varieties and the relative lack of varietal diversity from which to select. Tolerance of increased drought and desertification and resistance to pest damage are qualities of interest for the municipality. Although field testing of improved varieties (especially beans and maize) is ongoing in Santander and in the San Gil municipality in particular, increased focus must be placed on improving the availability and free accessibility of these resources in Curití.

2. Enable financial support mechanisms for practices with high start-up costs.

Water harvesting and storage projects, biogas and biodigesters, and efficient wood stoves have the potential to offer considerable benefits due to cost and input reductions and increased water availability. These also tend to be the practices that offer the most to women members of the household in terms of potential benefits. The high degree of technical knowledge and often prohibitive cost of the materials, tools and labor needed to install them, however, prevent their uptake on a wide scale. Increased investment from development institutions and further public-private partnerships are needed to facilitate their adoption.

3. Promote agricultural education programs, farmer field schools and on-farm trainings and trials for unfamiliar and/or technically demanding practices.
Conservation tillage and alternatives to chemical fertilizers and pesticides such as composting, 
vermiculture, and organic pest control are practices that would especially benefit from training 
based on experiential knowledge and learning-by-doing. The adoption of conservation tillage 
techniques in particular could be facilitated by improved knowledge dissemination as farmers 
were skeptical as to its benefits in comparison with deep tillage using a tractor. On-farm trials 
could serve to both calibrate farmer opinion and assess the practice’s potential for benefits 
with respect to soil fertility, organic carbon content and erosion reduction. Study participants 
also indicated a high degree interest in the potential of composting and organic pest control 
techniques to reduce their need for expensive agricultural inputs; lack of technical information 
on how to carry out these practices was the main factor inhibiting them from trying it on their 
farms.

4. Ensure CSA initiatives are funneled through the local Community Action Board for 
maximum reach and impact, and facilitate within-community organization and existing 
human capital for knowledge and labor sharing purposes.

Local Community Action Board representatives are well known by all members of the 
community and tend to serve go-betweens for the community and external institutions looking 
to increase their involvement there. The local government thus serves as an excellent point of 
departure for information dissemination and project development to the entire community. To 
ensure continuity of initiatives and knowledge sharing between households, steps should be 
taken to promote community-based organizations. Such actions could have particular benefits 
for CSA practices such as home gardening and composting, where the support of a small 
community group that share experiences and even labor requirements could be all that is 
needed to increase adoption rates of the practice. The importance of educational and 
governmental aid programs in the community should also be noted as possible conduits of 
agricultural information.

ACKNOWLEDGEMENTS
This research was funded by the CGIAR Research Program on Climate Change, Agriculture and 
Food Security Theme 1, “Long-Term Adaptation to Climate Change.” The author wishes to 
acknowledge A. Jarvis and O. Bonilla-Findji for the opportunity to conduct the research and for 
funding, travel and intellectual support, M. F. Oviedo for administrative support, and J. Twyman 
and C. Corner-Dolloff for collaboration on development of the initial concept and survey 
materials. M. Beltran and the Bioversity International team shared baseline survey data, 
working sites, logistical coordination, contacts, and companionship in addition to providing 
unparalleled support in the field. M. Beltran also made insightful comments and revisions on 
the original manuscript. E. Gomez Sanchez, F. Sanchez, F. Z. Aparicio Macias and L. Aparicio 
provided field support and translation. J. Rivera and A. Jinés helped in the preparation and 
editing of Spanish materials and L. Bermudez contributed to the preparation of the Colombia-
specific questionnaire. Finally, M. Acosta freely shared the methods, data and results of her 
thesis work to contribute to the development of this study’s methodology and the 
interpretation of its results.
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APPENDIX 1: Cuestionario Barreras para la Adopción de la CSA

Fecha (dd/mm/aaaa) __/__/__ __ __/ __ __ Hora __ : __ __

Nombre entrevistador ___________________________ Firma ________________________

Introducción y consentimiento

Antes de que se comience la entrevista, lea el siguiente párrafo y asegúrese que el encuestado entienda antes de pedirle su consentimiento.

"Buenos días/Buenas tardes. Estamos aquí para pedir su colaboración con una encuesta, que tiene como propósito entender las prácticas agrícolas que utiliza usted y por qué, y cómo se introducen nuevas prácticas en esta región. Nos gustaría hacerle unas preguntas que no deberían de demorarse más de una hora u hora y media. Nos gustaría compartir esta información para que más gente entienda cómo se cultivan los alimentos y cómo se maneja la tierra en esta región, y los problemas que usted(es) enfrenta con referencia al acceso y utilización de información y prácticas agrícolas. Su nombre no aparecerá en ninguna información que se dé a conocer públicamente. La información que usted proporciona se usará estrictamente para fines investigativos y sus respuestas no afectaran ninguno de los beneficios ni subsidios que podrá obtener actualmente o en el futuro. Usted tiene el derecho de retirarse de la investigación en cualquier momento y si encuentra preguntas que preferiría no contestar, usted no tiene ningún deber a contestarlas. Da usted su consentimiento para participar en esta investigación?

El encuestado ha proporcionado su consentimiento? (1=Sí, 0=No) [ ___ ]

1ª Sección: Datos acerca de la finca

1.1 Nombre del encuestado ___________________________

1.2 Sexo del encuestado (1=Hombre, 2=Mujer) [ ___ ]

1.3 Quién es cabeza de familia? [ ___ ]
0=Encuestado 3=Hijo
1=Esposo 4=Nieto
2=Padre 5=Otro (especifique) Nombre_____________________________

1.4 Cómo es la conformación del hogar? [ ___ ]
1=Encabezado por hombre, con esposa
2=Encabezado por hombre divorciado, soltero o viudo
3=Encabezado por mujer divorciada, soltera o viuda
4=Encabezado por mujer, esposo lejos
5=Encabezado por hijo/a menor de edad
Otro, especifique ____________________________

1.5a Con cuántas personas cuenta su familia, incluyéndose usted? [ ___ ___ ]

1.5b Cuántos de ellos tienen menos que 5 años de edad? [ ___ ___ ]

1.5c Cuántos de ellos tienen más que 60 años de edad? [ ___ ___ ]

1.6 Cuál es el nivel más avanzado de educación que ha logrado cualquier miembro de la familia? [ ___ ]
0=Ninguna educación formal
1=Primaria
2=Bachiller
3=Técnica o profesional

1.7 Qué es el tamaño de la finca (cultivos y/o pasto) y su vinculación con ella?
Propia [ ___ ___ ___ ]
Alquilada [ ___ ___ ___ ]
Prestada [ ___ ___ ___ ]
Comunal [ ___ ___ ___ ]

Cantidad (hectáreas)

1.8 Cuáles son los principales cultivos y ganado de la finca?

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Cultivos [ ___ ___ ___ ]
Ganado [ ___ ___ ___ ]
### 2da Sección: Prácticas climáticamente inteligentes

Preguntar juntos. Llenar columna completa antes de seguir a 2.2b

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<td>Mejoramiento de forrajos</td>
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<td>Manejo integrado de plagas</td>
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<td>Recogimiento de semillas autoctonas</td>
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<td>Rotación de cultivos</td>
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<td>Rotación de polímeros</td>
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<tr>
<td>Siembra atravesada, de contorno, trinches, terrazas</td>
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<tr>
<td>Sistemas agroforestales, silvopastoriles</td>
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<td>Sistemas de riego</td>
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<td>Sustitución de agroquímicas</td>
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<tr>
<td>Variedades resistentes al estrés, alto rendimiento, maduración temprana</td>
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</tbody>
</table>

1=Sí, 0=No  

Si fuera posible, usted introduciría o volvería a introducir [practica] en su finca?
2.5 (Llene para prácticas marcadas como SI en 2.1) Cuáles son los beneficios, si los hay, que percibe usted al utilizar [práctica]? 2.6 Cuáles son los dificultades de inconvenientes?

<table>
<thead>
<tr>
<th>Práctica</th>
<th>Beneficios</th>
<th>Inconvenientes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 – Mejor rendimiento de cultivos</td>
<td>1 – Menor rendimiento</td>
</tr>
<tr>
<td></td>
<td>2 – Mejor fertiliad y/o estructura del suelo</td>
<td>2 – Difícil obtención de materiales</td>
</tr>
<tr>
<td></td>
<td>3 – Menor riesgo de pérdidas relacionadas con sequía</td>
<td>3 – Mayores requisitos laborales</td>
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<tr>
<td></td>
<td>4 – Menor riesgo de pérdidas relacionadas con inundación</td>
<td>4 – Mayores costos para ingresos</td>
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<td></td>
<td>5 – Mejor seguridad alimentaria domestica</td>
<td>5 – Mayor incidencia de enfermedades/plagas</td>
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<tr>
<td></td>
<td>6 – Mayores ingresos domésticos o ingresos más diversificados</td>
<td>6 – Pobre calidad de productos</td>
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<tr>
<td></td>
<td>7 – Menores requisitos laborales</td>
<td>7 – Altos costos iniciales</td>
</tr>
<tr>
<td></td>
<td>8 – Menor erosión del suelo</td>
<td>8 – Ningún mercado para productos</td>
</tr>
<tr>
<td></td>
<td>9 – Mejor absorción y retención del agua en el suelo</td>
<td>9 – Mayor riesgo de pérdida de cultivos/ganado</td>
</tr>
<tr>
<td></td>
<td>10 – Mejor acceso al agua</td>
<td>10 – Mayor riesgo de pérdida financiero</td>
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<tr>
<td></td>
<td>11 – Mejor acceso a los materiales para alcochado/cubierto vegetal o mejor acceso a estiércol para abono</td>
<td>11 – Menor fertilidad del suelo</td>
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<tr>
<td></td>
<td>12 – Mayor disponibilidad de forraje/agua para ganado</td>
<td>12 – Mayor presencia de hierbas malas</td>
</tr>
<tr>
<td></td>
<td>13 – Productos forestales (madera, leña, frutas, etc.)</td>
<td>13 – Reducción en área disponible para cultivo</td>
</tr>
<tr>
<td></td>
<td>14 – Servicios ambientales (sombra, lluvia, micro-clima, biodiversidad)</td>
<td>14 – Presencia de animales peligrosos</td>
</tr>
<tr>
<td></td>
<td>15 – Prevención de enfermedades/plagas</td>
<td>15 – Ningún dificultad observado</td>
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<tr>
<td></td>
<td>16 – Mayor productividad ganadera</td>
<td>Otro, especifique</td>
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<tr>
<td></td>
<td>17 – Mayor nutrición ganadera</td>
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<td></td>
<td>18 – Mayor calidad de productos</td>
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<td></td>
<td>19 – Menor costos para ingresos</td>
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<td></td>
<td>20 – Acceso más fácil o más seguro a ingresos</td>
<td></td>
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<tr>
<td></td>
<td>21 – Seguros en caso de pérdida de cosecha</td>
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<td></td>
<td>22 – Diversificación de producción</td>
<td></td>
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<tr>
<td></td>
<td>23 – Menor riesgo de pérdida de cultivos o ganado</td>
<td></td>
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<td></td>
<td>24 – Mejor nutrición/bienestar humano</td>
<td></td>
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<td></td>
<td>25 – Ningún beneficio observado</td>
<td></td>
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<tr>
<td></td>
<td>Otro, especifique</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ningún beneficio observado</td>
<td>Otro, especifique</td>
</tr>
</tbody>
</table>
**Llene preguntas 2.7 hasta 2.11 para las prácticas indicadas en 2.2b**

<table>
<thead>
<tr>
<th>Práctica (Diligencie según 2.2b)</th>
<th>2.7</th>
<th>2.8</th>
<th>2.9</th>
<th>2.10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Por qué decidió empezar a utilizar [práctica]?</td>
<td>Cuál es su fuente principal de información acerca de [práctica]?</td>
<td>Quien tomó la decisión de empezar a utilizar [práctica]?</td>
<td>Quien hace la mayoría del trabajo para realizar [práctica]?</td>
</tr>
</tbody>
</table>
| 2.7                              | – Mejor rendimiento de cultivos 1  
  2 – Mejor fertilidad y/o estructura del suelo  
  3 – Menor riesgo de pérdidas relacionadas con sequía  
  4 – Menor riesgo de pérdidas relacionadas con inundación  
  5 – Mejor seguridad alimentaria doméstica  
  6 – Menores ingresos domésticos o ingresos más diversificados  
  7 – Menores requisitos laborales  
  8 – Menor erosión del suelo  
  9 – Mejor absorción y retención del agua en el suelo  
  10 – Mejor acceso al agua  
  11 – Mejor acceso a los materiales para acolchado/cubierto vegetal y/o mejor acceso a estiércol para abono  
  12 – Mayor disponibilidad de forraje/agua para ganado  
  13 – Productos forestales (madera, leña, frutas, etc.)  
  14 – Servicios ambientales (sombra, lluvia, micro-clima, biodiversidad)  
  15 – Prevención de enfermedades/plagas  
  16 – Mayor productividad ganadera  
  17 – Mayor nutrición ganadera  
  18 – Mayor calidad de productos  
  19 – Menor costos para inputs  
  20 – Acceso más fácil o más seguro a inputs  
  21 – Seguros en caso de pérdida de cosecha  
  22 – Diversificación de producción  
  23 – Menor riesgo de pérdida de cultivos o ganado  
  24 – Mejor nutrición/bienestar humano  
  25 – Ningún beneficio observado  
  Otro, especifique | 2.8 | 2.9 | 2.10 |
| 2.7                              | 1 – Agentes de extensión  
  2 - ONGs  
  3 – Reuniones de la comunidad  
  4 – Organizaciones de agricultores  
  5 – Centros de investigación/investigadores  
  6 – Grupos religiosos  
  7 – Proveedores de agro-servicios  
  8 - Familiares  
  9 - Vecinos  
  10 - Radio  
  11 -Televisión  
  12 – Periódico/boletín  
  13 – Instituciones educativas/maestros  
  14 – Celular  
  15 – Internet  
  16 – Conocimiento tradicional  
  17 – Exposiciones agrícolas  
  18 – Talleres o entrenamientos  
  19 – Propia experiencia  
  Otro, especifique | 2.9, 2.10 | 1 – Hombre  
  2 – Mujer  
  3 – Ambos hombre y mujer  
  4 – Niño  
  5 – Niña  
  6 – varios miembros de la familia |
2.12 (Llene para prácticas marcadas como SI en 2.3) Por qué dejo de utilizar [práctica/s]?

2.13 (Llene para prácticas marcadas como SI en 2.4) Qué tendría que pasar o cambiar antes de que usted podría introducir/re-introducir [práctica/s] si deseaba?

2.14 (Llene para prácticas marcadas como NO en 2.4) Por qué no le interesa utilizar [práctica/s]?
APPENDIX 2: Sample semi-structured interview checklist

- How long have you been farming on this particular piece of land?
- How did the farm look x years ago compared to how it looks now?
- How did your village look x years ago compared to how it looks now?
- What do you think are the reasons for some of these changes?
- What was the climate like x years ago compared to what it is like now?
- Do you use any practices or techniques that you did not use when you first started farming?
- How did you first learn about these techniques?
- What has been your most important resource for learning about good agricultural practices?
- Which of the new practices you have introduced has been the most important for your farm’s productivity?
- Have a lot of people in your village adopted these practices, or are they uncommon?
- If they are not widely adopted practices, why do you think that is the case?
- Which part of your farm are you most proud of and why?
- What part of farming nowadays do you find most difficult? Is farming now easier or harder than it was x years ago?

APPENDIX 3: Sample guiding questions for focus group discussions

- What is the main obstacle to obtaining sufficient food for the household?
- When food becomes scarce, how do you resolve the problem?
- How have your agricultural activities been affected by the strength of the dry season?
- What change have you made to your agricultural activities to account for climatic changes or challenges?
- Which of these practices has worked well? Are there some that have not worked well? Why?
- What are the most important crops in the village?
- What varieties of these crops are available?
- What are the characteristics of each variety and which characteristics are the most important for productivity and food security?
- What are the most important climatic events during the year? How have these events changed in recent years?