



**Food and Agriculture Organization
of the United Nations**

JANUARY 2016



GENDER INTEGRATION INTO CLIMATE-SMART AGRICULTURE

**Tools for data collection and analysis for policy
and research**

Gender integration into climate-smart agriculture Tools for data collection and analysis for policy and research

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**Food and Agriculture Organization of the United Nations
Rome, 2016**

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Table of contents

1. Introduction	1
2. The need for measuring food security in assessing CSA	2
2.1 Measuring the food security benefits of CSA	2
2.2 Differentiated gender-adaptation responses to food security	3
2.3 The need to measure mitigation activities from a gender perspective	4
3. Methods of gender analysis in CSA	5
3.1 Quantitative methods	5
3.2 Qualitative methods	6
3.3 Mixed methods	6
4. Data collection for gender analysis in CSA	7
4.1 Tools for data at household and plot level	7
4.2 Tools for data at super-household level	10
5. Conclusion	10
References	11



Acknowledgements

This paper was written as background document for “Gender in climate-smart agriculture: module 18 for gender in agriculture sourcebook”, which was published in 2015. We would like to thank Kaisa Karttunen, Ilaria Sisto, Leslie Lipper (FAO), Ingrid Mollard (consultant), Sanna-Liisa Taivalmaa (World Bank) for their thorough review and constructive comments.

1. Introduction

Climate-Smart Agriculture (CSA) seeks to support countries in securing the necessary policies, as well as the technical and financial conditions, to enable them to i) sustainably increase agricultural productivity and incomes; ii) build both the resilience and the capacity of agricultural and food systems to adapt to climate change, and iii) seek opportunities to reduce and remove greenhouse gas (GHG) in order to meet their national food security and development goals. The adoption of CSA practices at scale requires appropriate institutional and governance mechanisms to facilitate the dissemination of information and to ensure broad participation by relevant stakeholders and targeted beneficiaries. CSA is site-specific and considers the synergies and trade-offs between multiple objectives that are set in diverse social, economic, and environmental contexts. Among the drivers influencing CSA adoption, the understanding of how gender could influence the effectiveness of these instruments is capturing increasing attention in the literature (Okali 2011; Stienecker, 2012; Watt, 2012). Recent studies show that youth and women have a different degree of vulnerability compared to that of men for many reasons, including their greater dependence on natural resources for livelihoods, responsibility for food production, water and fuel for their households, more limited assets, and social, cultural and political barriers.

In dealing with CSA adoption, as well as with agricultural technology adoption, there has been increasing recognition of the importance of focusing on the gender-heterogeneity behind the adoption choice itself.¹ For example, an outcome may depend on whether the decision-maker is the husband or the wife, as well as if the decision-maker is also the household head.² To understand gender dynamics in agriculture it is not sufficient to compare male to female farmers or male- to female-headed households. Instead, we need to understand the heterogeneous system of household behaviour embedded in the agricultural economy and to analyse the different situation of women in both male- and female-headed households in terms of their access and control of productive resources, services and employment opportunities.

The household, then, should not be considered as a unified economic entity, but as a network of interactions between different agents that act together to maximize their own outcome. In this framework, gender plays a role in the decision-making over the allocation, negotiations and exchange of resources and labour. This is an extremely complex issue, but CSA adoption itself depends on complex interactions that defy simple characterizations. The integration of gender into CSA also means understanding how gender, and thus its adoption of CSA practices, will evolve together with climate change in the future. To evaluate the effectiveness of CSA in turn would require choosing a set of indicators that are appropriate to carry out such comparisons across the three pillars of CSA: adaptation, food security, and mitigation. In the next sub-section we provide a brief review of options and point to indicators that have the potential to be used based on available data.

¹ Haddad, Hoddinott and Alderman (1997)

² *Ibid.* show that several other sources of heterogeneity could arise due to the composition of the household or its spatial distribution.

2. The need for measuring food security in assessing CSA

In the CSA framework, the interconnections between climate change adaptation, mitigation and food security are so heterogeneous and pervasive that it is challenging to disentangle all the effects that an agricultural practice/policy could have on present and future households' livelihoods (McCarthy, 2011). For example, farmers could invest in instruments moderating the future impact of climate change without addressing food security, or even increasing the variability of food production during extreme events. In the case of a developed country climate change would not present any risk in food consumption; however, in developing countries it could result in worsening present living conditions of farmers. Moreover, without integrating gender into the CSA framework, other problems may arise in measuring the effectiveness of different policies/instruments on the final benefits, measured in terms of adaptation, mitigation and food security.

Quisumbing and Pandolfelli (2010) report an example of successful gender-responsive policy adoption in Bangladesh, where social norms do not allow women to mix publicly with men. Therefore, NGOs targeted women as beneficiaries of improved vegetable technologies that could be cultivated on homestead land, allowing them to avoid the loss of their reputations. Several other determinants should induce the implementation of a gender-responsive policy and the employment of different indicators for estimating policy results. For example, as shown by Beuchelt and Badstue (2013), the implementation of different policies requiring a high investment in time of labour (e.g. stone bound and terraces) could be especially costly for households with few prime-age adults or with more women of working age than men. Thus, the use of a set of appropriate gender-sensitive indicators on food security, adaptation and mitigation has a crucial role in evaluating the best practices in an agricultural development plan.

2.1 Measuring the food security benefits of CSA

Disentangling CSA practices that would benefit women on the basis of their particular social and economic conditions, from practices that would require excessive labour or monetary investment on their part, could represent a first step in building up a gender-sensitive indicator for measuring food security. The following methodologies have been used in the literature for the development of indicators integrating gender into a CSA strategy:

- Establishment of the links between climate change and agricultural productivity, and then establishing the relationship between agricultural productivity and household food consumption expenditure or poverty (Karfakis *et al.* 2011).
- Measurement of household members' perception of their access to food. Calculating how CSA adoption would increase these indices, and then disentangling this measure at gender level, could represent a second indicator to be used for the measurement of food security benefits of CSA strategies.
- Construction of an indicator on the occurrence of money shortages in a given reference period as a proxy for food insufficiency, and consequently correlation of this measure with the gender of the household members (Floro and Swain, 2013).

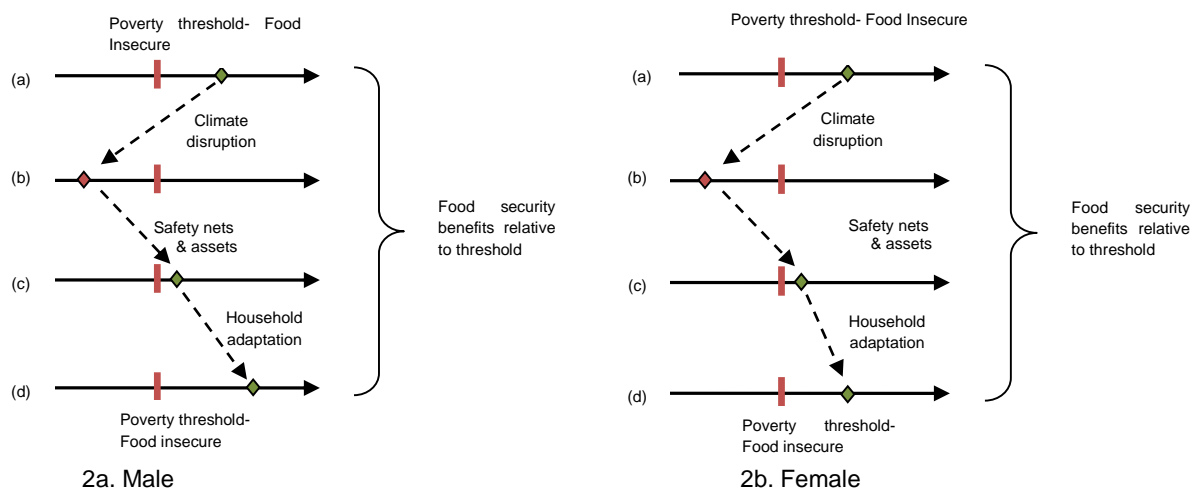
Estimating how CSA adoption would influence this index could indicate the gender-differentiated effect of CSA policies.

- Calculation of a diversification index built on the coefficient of variation of market revenue when changing the portfolio of commodities produced, while keeping the variability of yields constant (Kimura, Antón, LeThi, 2010). Changes in the index's value are interpreted as a reduction in variability of profits due to the farmer's new choice in the composition of commodities in the farm production portfolio. In this case as well, gender dimensions and preferences play a significant role in determining which technology would be adopted in the farm production portfolio.

2.2 Differentiated gender-adaptation responses to food security

In a general framework, adaptation related to food security can be defined as the extent to which income is increased or stabilized to an acceptable livelihood level by a combination of the following: (i) productivity increases and reduced variability by adopting certain practices; (ii) diversifying livelihood strategies on the farm; and (iii) diversifying income through off-farm activities. Modifying the general definition of adaptation developed by Heltberg *et al.* (2009), gender-responsive household-level adaptation is typically referred to as "autonomous adaptation" differentiated at gender-level. The Figure below presents gender-differentiated variation in the food security level after a weather shock when receiving benefits from safety nets and from adaptation. This model has been further extended by McCarthy (2011) and Karfakis *et al.* (2011) to include adaptation to climate change at gender-differentiated level. Karfakis *et al.* (2011) consider the impact of climatic disruption on the likelihood of households falling below the poverty line due to decreased productivity, accounting for access to safety nets and assets. Here we extend the approach by including the different forms of autonomous adaptation listed in the previous paragraph, and we set a scenario in which females are less able to adapt compared to males.

Figure. Food security relative to the poverty threshold



Source: based on Cattaneo *et al.* (2012).

Note: (a) households' normal food security level; (b) impact of climate disruption on food security; (c) safety nets and assets raising households above the poverty line but not to normality; (d) household adaptation is needed to return to equilibrium.

The main challenge in empirical assessments of food security benefits is to avoid attributing to CSA adoption food security benefits that may have other causes. There are many factors that affect differences in adoption by farmers depending on the gender and that, if not carefully controlled for, may confound the effects of CSA. For example, many studies have highlighted productivity differentials between male and female farmers, and usually farmers who adopt certain practices may also be the ones that are more likely to have higher efficiency in production due to unobserved factors such as ability or openness to innovation (Quisumbing and Pandolfelli, 2010).

Adaptation patterns are also heterogeneous across gender lines and this selection effect can lead to an overestimation of adaptation benefits if not accounted for. Ezezika *et al.* (2012) confirm the need to consider women's adaptation determinants in order to implement successful agricultural policies. Therefore, when focusing on adaptation strategies it is necessary to disentangle the instruments that could be accessible by women in terms of labour requirements, resources, time allocation and physical strain. The challenge is to estimate the potential benefits of adaptation strategies in terms of food security for both genders in order to evaluate which strategy better satisfies each gender without requiring an unaffordable cost (Momsen, 2010). For example, in some countries only men have the right to cultivate certain crops and the right of access to the market in case of a shock on production (Erenstein *et al.* 2012). These social barriers increase the complexity for women to differentiate their production and to adapt to climate change.

In general, a proper adaptation indicator should focus on all the main drivers of gender outcomes that are specific for a certain country at a given time. It is therefore necessary to understand that in each society women are entitled to different rights and face different barriers, making it difficult to generalize the results on women's adaptation obtained conducting a limited and localized analysis. In certain countries women cannot adapt by diversifying their income through off-farm activities because of social norms; this would consequently influence their vulnerability, their income, and their possibility of affording the cost of diversification of farming practices (Hallward-Driemeier and Hasan, 2012). Other evidence suggests that women receive less than 10 percent of the credit granted to small farmers in Africa (Anyanwu, 2004). Without credit, they would not be able to buy the crucial inputs needed to adapt to environmental stress, such as new varieties of plant types intended for higher drought or heat tolerance. An indicator not taking into account these differences across gender lines would overestimate the adaptation of women and underestimate that of men, and so provide a misleading indication.

2.3 The need to measure mitigation activities from a gender perspective

According to Scherr, Shames, and Friedman (2012), roughly 30% of the world's greenhouse gas emissions come from land use, and between 10% and 12% derive from crop production. In this context it becomes necessary to develop a proper indicator on the predicted impact of mitigation activities, both at an aggregated and at a gender-responsive level. A hypothetical gender-responsive indicator on mitigation should be able to distinguish the potential impact of mitigation strategies by both gender categories. It can be assumed that some mitigation practices conducted by women could have a higher/lower impact on greenhouse gas (GHG) emissions, and this should be taken into account when measuring potential mitigation effects of the strategies adopted. For example, some agroforestry

practices or perennial plantings require an extraordinary amount of working time that women, expected to care for the entire household, cannot afford. This miscalculation could determine an incorrect implementation of the practices and, consequently, a lower level of impact on GHGs emissions. Therefore, when dealing with the construction of a gender-responsive indicator on mitigation, it will be necessary to consider both the sex of the adopter and the gender composition of the adopter's household.

In general, proper indicators for climate change mitigation should revolve around precise measurement of the gases emitted or of the carbon sequestered. Global Warming Potential (GWP), nowadays the most used metric, compares the impact over a specific time horizon of a 'pulse' emission of one unit of a specific gas. Employing this measure, emissions are expressed as tons of carbon dioxide (CO²) equivalent, using CO² as a normalizing factor. However, the difficulties in measurement for the different gases and the uncertainty on the reliability of these measurements typically decrease the attractiveness of mitigation activities, hiding possible future benefits for farmers. Some of the uncertainty is associated with agricultural carbon sequestration activities, which will need to be addressed when accounting for the GHG from a gender perspective. Among the sources of uncertainty for measuring mitigation:

- Uncertainty over activity implementation and over accounting of the land area involved;
- Uncertainty deriving from emission factors attributable to mitigation actions;
- Uncertainty due to lack of scientific documentation of the impacts of management practices on non-CO² emissions

3. Methods of gender analysis in CSA

In the context of creating an evidence base for CSA, the objective is to establish linkages between the CSA practices and household food security outcomes, taking into account heterogeneity across gender lines. The type of methodology to be used in the gendered analysis, quantitative or qualitative, will be a crucial factor in determining the way in which data will be collected.

3.1 Quantitative methods

Quantitative methods are most employed by applied economists when evaluating, exploring and integrating knowledge using a large set of information available in standardized questionnaires. An important requirement for conducting an empirical study is the employment of highly detailed and reliable questionnaires from which researchers might extract causal relations between any social or agricultural phenomenon and environmental events. Sampling of the data usually requires covering the range of interest to the analysis. Thus, a study related to CSA and gender should be representative of gender conditions at the national or sub-national level. In surveys, individual-level data should be collected with a common identifier for all the members in the same household in order to track common characteristics and features. An extensive set of statistical techniques have been developed to ensure that results obtained in the analysis will be rigorous and descriptive of the real phenomenon observed. When dealing with CSA and gender, it will be important to focus on

all the determinants of gender-differentiated adoption of CSA. Therefore, data collection would need to highlight:

- Practices adopted at individual level for both sexes;
- Women's accessibility to resources and agricultural technology;
- Labour status and women's rights;
- Land ownership and conditions for both sexes;
- Social norms and several other aspects linked to women's lives.

Ideally, for conducting a quantitative study, data collection from the same households over time (panel data) should successfully track agricultural production, income sources and consumption over several years.

3.2 Qualitative methods

Qualitative methods are usually employed when the outcome of interest is simply not reducible to standard measurement techniques or quantitative analysis. When focusing on gender relations, researchers often wish to encompass all the interconnections between wellbeing, status, empowerment, and social rules that cannot be easily captured through the usage of common surveys. For example, the concept of "controlling" the plot with a certain CSA practice could imply a very different concept than "owning" that plot. To overcome this caveat, researchers usually employ qualitative studies, which allow respondents to express their opinions freely without any constraints caused by pre-determined questionnaires. Employing this methodology, it is possible to capture gender roles in agriculture and non-agricultural activities, dynamics of inter-household and intra-household negotiations, determinants of asset management and other sensitive topics influencing CSA adoption that may be not revealed in common surveys. In addition, with this type of analysis it would be possible to investigate the overall perceptions of male and female producers on the usefulness of CSA practices, their participation in all the decision-making processes when dealing with adoption choice and also individual perceptions of the extent to which women adopt certain practices as well as their reason for the adoption.

Part of this methodology is often described as a participatory methodology, because it involves the participation of the respondent in determining which information will be shared during the process of evidence collection. In our framework, applying a gender disaggregated participatory methodology to data collection on adoption of CSA implies involving women in identifying the barriers and constraints that they face when dealing with CSA practices.

3.3 Mixed methods

The co-integration of qualitative and quantitative methodologies in numerous ways, linking data from different sources and fields of study, has paramount importance. Qualitative studies can be used to identify types of gender indicators or impacts that may be addressed and fitted into a survey's questions. Furthermore, qualitative work could explain findings of quantitative studies and make explicit the story behind the statistical evidence so as to open new research questions for quantitative researchers. Concurrently, quantitative studies

could be used to understand how to stratify the sample for the qualitative analysis, especially within-gender, in order to capture the causes of adoption of certain CSA practices. Finally, the usage of both quantitative and qualitative research could help in testing prediction and controlling for contradictions in findings obtained with the other methodology, thus to obtain a broad overview of all the possible determinants of CSA adoption and food security at gender-level.

4. Data collection for gender analysis in CSA

While there is increasing awareness of the importance of including women in agricultural policy planning, either through programs targeting only women or through mainstreaming approaches, there are still key data gaps that inhibit the development of appropriate policies and monitoring progress towards a sustainable development. To address several questions related to agriculture in developing countries, such as those related to the adoption of CSA and technologies that could improve smallholders' welfare, an analysis using data respecting diverse requirements should be developed. In considering the data needed, it is important to focus on who should be interviewed and how to structure the interview. These will depend on the research or policy questions that need to be answered, and the appropriate unit of analysis; are we interested in the farmer, the household, the plot of land, a particular crop, or the farm enterprise? These different units of analysis will lend themselves to different types of surveys. Broadly, the types of surveys that are used for analyses of CSA include household surveys, plot surveys, and super-household surveys. Each provides different information and helps to answer different questions. Each type of survey has its strengths and weaknesses and should be considered in the context of the broader research questions.

4.1 Tools for data at household and plot level

Often, researchers measuring the gender gap invest time in the development of a questionnaire that could cover all the possible topics of interest from a sex-disaggregated perspective (Doss, Grown and Deere, 2011). Data should be collected at individual-level, rather than just at the household or farm level, specifying the agricultural holding and the exact holder. This type of data collection will facilitate analyses on a broad range of dimensions, such as age, labour status and gender.

There are numerous ways to present data with policy implications at household/individual-level considering gender. Among the categorizations that could be used, data could indicate adoption by (i) women farmers or female-headed households; (ii) men or male-headed households; and (iii) couples within the household. However, as confirmed by Doss (2014), surveys previously lacked information about gender, making the appropriate identification of the respondent impossible. FAO (2005) started to recommend data collection for joint as well as individual holders of parcels, where the holder is defined as the person making decisions on the parcels.

Specific questions on the individual taking the adoption decision and his/her sex should be added to generate a comprehensive survey on policy implications (Doss, Deere, *et al.* 2011).

Information could also be collected at plot-level, and disaggregated by sex, but in this case it would be necessary to make explicit:

- The manager the plot and owner of the plot;
- The sex of the manager/owner;
- The area of the plot;
- The type of CSA practices adopted in the plot by men and women;
- The type of crops cultivated in the plot by men and women.

Incorporating gender analysis into discussions of CSA adoption would require expanding the survey beyond the adoption decision itself by including questions that would provide better insights on constraints faced by women, such as questions on time-allocation and labour supply decisions. Household surveys usually focus on smallholders, providing details on household demographic and social characteristics, their labour market conditions, and agricultural facilities. The identification of the barriers faced by women, together with the development of strategies to overcome these barriers, could provide benefits both for correct implementation of CSA strategies and for other policies addressed to the general improvement of women's conditions in the country analysed. In case of information collected at plot/crop-level it could be possible to disentangle the effect of each CSA instrument by crop and gender with much more detail.

Box: Costs and Benefits of CSA in Malawi /Zambia/Viet Nam: Data Collection and Empirical Strategy

In the context of producing a base of evidence for CSA, undertaking a Cost-Benefit Analysis (CBA) has been useful in evaluating the net benefits or costs of adopting certain practices versus conventional agriculture, taking into account local economic and climatic conditions. Analytical steps undertaken on the research activity of CBA involved: i) identification of target CSA practices and definition of conventional agriculture; ii) statistical sampling and field data collection (HH and Community); iii) data analysis.

Identification of target CSA practices has implied the definition of what is CSA for each of the country considered. Indeed, there is not a recipe that fits in all contexts for CSA. CSA is rather context-specific, depending on the climate, agro-ecology, socio-economic and institutional settings. There is also a need to specify what conventional agriculture in each country entails. Conventional agriculture was therefore identified as the most largely and traditionally adopted practice in each country. CSA was to respond first to the very concept of CSA, hence it had to be identified among the non-common practices and it had to be already adopted (through projects, interventions, subsidies), with possibility of scaling-up. CSA has, thus, assumed a context-specific characterization and CBA has included the following process:

QUALITATIVE ANALYSIS:

- Compilation of a long list of practices built through local workshops involving key stakeholders (Ministry of Agriculture officers, extension services, farmer associations);
- Stocktaking of CSA practices through literature review, including grey literature, project data and documents;
- Validation of list of selected practices through field visits, talking to key farmers and extension agents and through documentation of projects and interventions;
- Compilation of survey tools and conduction of enumerator training and pilot phase for data collection which includes a large amount of feedback and input;
- Final validation of conventional agriculture and CSA practices by the end of the pilot phase.

Shortlisted CSA practices in each country-study		
Malawi	Zambia	Viet Nam
<p>Minimum soil disturbance (planting basins, ripping, zero tillage); residue retention/mulching; crop rotation with legumes; presence of soil and water conservation physical structures</p> <p><i>Crops targeted: maize, cassava, sorghum, groundnut, tobacco, cotton, soybean and legumes (peas, beans, etc.)</i></p>		<p>Minimum tillage and mulching; crop rotation/intercropping with legumes (crops with annual or perennial crops, excluding forest trees); sustainable paddy rice intensification (ICM and/or SRI and/or IPM or...); forage production (fodder grass production for intensive cattle raising); (mini)-terracing; rice FDP (fertilizer deep placement - on paddy).</p> <p><i>Crops targeted: upland maize, upland cassava; upland rice; lowland rice (paddy); upland coffee, upland tea.</i></p>

QUANTITATIVE ANALYSIS

The qualitative analysis has led to the formulation of country-specific questionnaires, sampling and empirical models for data analysis. During the construction of the survey tools, the following steps have had a paramount importance:

- Development and testing of household and community questionnaires to collect key benefits and costs in addition to other key data at household level (demographic characteristics and assets, cropland use and management, livestock management, other incomes and access to credit, institutions and extension) as well as at the community level (labour and other farm inputs, prices, access to extension and information services, rainfall perception).
- Identification of target areas where shortlisted CSA practices are adopted and construction of stratified sample of HHs for the survey.
- Construction of samples of communes where the community survey is conducted.
- Primary data collection and data entry.
- Data cleaning, final empirical validation and data analysis.

In undertaking data analysis, gender roles and gender disaggregated variables are being taken into account. Nevertheless in dealing with gender in CSA, it is strongly recommended to pay attention to gender differentiated roles and aspects in undertaking the qualitative analysis so as to account for gender in selecting the sample, and thus to allow for the gender disaggregated analysis that leads to interesting insights and policy implications.

It will be an advantage to develop a panel dataset as it allows one to uncover dynamic relationships between genders and to understand the role of gender heterogeneity in explaining adoption and investment behaviour over time, as well as affording a greater ability to control for omitted variables, particularly with regards to program selection bias (McCarthy, 2011). In terms of understanding dynamic processes, McCarthy (2011) points out that many household-level CSA investments that reduce exposure to climate variability entail relatively large outlays upfront and are often gender-specific. However, full benefits to these investments may not accrue for several years (e.g. improvements in soil quality and water management due to investments in stone bunds, terraces or agro-forestry). Using cross-sectional data, it is often difficult to capture the real effects of CSA adoption and the dynamics of investments at gender-level. Cross-sectional surveys often provide limited data from which to uncover distributional impacts over the range of households, particularly where these households are heterogeneous along key dimensions. For a long time, this data issue has masked the real reasons why the failure to adopt such technologies has been so widespread, even where “average” net returns are quite high (Suri, 2011).

4.2 Tools for data at super-household level

Variables collected at the super-household level measure the characteristics of the community or institution where the household resides. This type of information is necessary in order to capture any possible effect that the environment could have on the decision to adopt a CSA strategy and on how gender interacts differently with environmental determinants. In general, community-level data are employed to include in the analysis variables capturing CSA adoption at community-level, especially when it is not possible to rely on data at household level. Employing these data, researchers often compare the adoption patterns of all the households residing in the community. However, by ignoring the gender dimension, this type of data collection could overestimate/underestimate the proportion of females adopting a certain CSA strategy inside a community, and then the policy indications deriving from an eventual analysis would misrepresent the gender conditions. By gathering responses to sex-disaggregated questions at community level it would be possible to overcome this barrier. Other sex-disaggregated data could consist of tracking adoption of CSA by neighbours, the type of infrastructure that women could access, and the presence in the community of NGOs promoting gender-specific CSA policies. Additionally, several dimensions could play a role in influencing both the skill of the farmers and the capability of having a forward-looking perspective on the possible effects of climate change, and thus indirectly on the decision of adoption of CSA techniques. These measures could include indicators on social norms, corruption and cultural values of the community.

5. Conclusion

- The aim of this note is to provide some insight on the data and tools necessary when dealing with the analysis of the effects of CSA on food security, focusing on a gender perspective.
- As evidenced in the note, only recently has the literature started investigating the role of CSA on food security, and some gaps can be identified, especially in measuring the contribution of mitigation practices on food security. One of the key questions not addressed in the literature refers to the possible gender-responsive impact of CSA in terms of food security.
- This note tries to provide an understanding on what could be the main dimensions on which we should focus on for answering this question. Describing the qualitative and quantitative methodologies, the study shows that both types of instruments could provide useful information towards understanding barriers to adoption and improving women's conditions.
- Data at household-level need to be sex-disaggregated and to go beyond the adoption choice itself, including questions that would provide better insights on constraints faced by women. Panel datasets should be preferred and attention should be paid on understanding dynamic processes inside the household. Finally, community-level data would need to be gender-informative, in order to cover eventual gaps in household-level data.
- This note should serve as guidance for readers that would like to engage in the study of CSA and gender. In general, this note does not aim to be comprehensive and complete but it indicates the main challenges and tools identifiable for this type of study.

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Economics and Policy Innovations for Climate-Smart Agriculture (EPIC)

EPIC is a programme hosted by the Agricultural Development Economics Division (ESA) of the Food and Agriculture Organization of the United Nations (FAO). It supports countries in their transition to Climate-Smart Agriculture through sound socio-economic research and policy analysis on the interactions between agriculture, climate change and food security.

This paper was written as background paper for “Gender in climate-smart agriculture: module 18 for gender in agriculture sourcebook”, which was published in 2015.



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