Activity Report

"Gender disaggregated CSA adoption trends: Results from two different surveys in Tuma-La Dalia in Nicaragua"

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Introduction

A large body of evidence emphasizes on the importance of applying a gendered approach to understanding the impact of climate change and adaptation and mitigation strategies in the development and environment research and policy (Fordham 2004, Meinzen-Dick et al. 2014, Quisumbing and Pandolfelli 2010, McKune et al. 2015, Ngigi et al. 2017). This is because the evidence shows that climate change effects men and women farmers differently due to the **unequal division of labor and resources** as well as the **gendered expectations imposed by norms in a patriarchal society.** To lessen the impact of climate variability on smallholders, various organizations including CCSFS have been implementing adaptive and climate smart practices to increase farmers' resilience to climate change effects. The adoption and implementation of these practices depends on various factors including **individual characteristics, financial and physical resources, access to services and information** (Ngigi et al. 2017, Nelson 2011, Adger et al. 2009). The **motivations** for uptake of technologies and practices could differ between men and women as they have different needs, preferences and expectations. It is important to consider this difference while analyzing the adoption patterns and constraining and motivating factors of adoption.

In this paper, we present the gender disaggregated adoption and implementation patterns of different adaptation practices by rural communities in Tuma-La Dalia in Nicaragua. **The analysis considers gender differences in knowledge, sources of information and intra-household dynamics related to adoption of CSA and other adaptive practices**. We present results from a baseline survey of intra-household aspects of farming households conducted in Tuma La Dalia during September and October 2015 and from CSA monitoring survey conducted in the same site during 2018. The results of this paper **analyze the socio-economic factors motivating and constraining adoption** of practices. The paper presents the existing patterns of adoption, sources of information and decision-making related to adoption, and recommends ideas and methods for improving data collection to construct a framework to analyze gender-sensitive determinants of adoption.

Methods and Data

In this section, we describe the methodology employed in the two surveys used for data analysis in this paper. The first survey is a **baseline survey of intra-household relations** including decision-making aspects in productive and reproductive activities, control and owner of assets, and decisions related adoption of agricultural practices. In addition, the baseline survey collected information on land ownership and production of staple and horticultural crops. In this paper, we make use of the practices module to understand the gender dynamics in adoption and implementation of technology. The baseline survey was conducted during September and October 2015 by the team of researchers at CIAT and CCAFS. The total number of households

surveyed is 271, of which 76% are couple-households, 11.4% are female-headed households, 5.5% are households with a single man/woman with other adult decision-maker and the last 6.6% of the households are only male-headed households (Twyman et al. 2016).

The sampling methodology in the baseline survey employed simple random sampling in 10 *veredas* (villages) of Tuma-La Dalia. All of these veredas belong to the area of the CCAFS Climate-smart Villages. Fro more details on the sampling methods please see Twyman et al. 2016.

Monitoring survey 2018 -The Climate-Smart Village Multilevel Monitoring Plan developed by CCAFS consists of a robust, cost-effective and friendly ICT-based instrument that provides standard CSA metrics and can be rapidly, reliably and systematically deployed across the global CCAFS Climate-Smart Villages network. It was implemented in April 2018 by local enumerators trained by the by the team of researchers from CIAT/CCAFS using a *Smart Monitoring App* for the data collection.

Based on a principle of simplicity in structure and design, the App provided friendly access to short sets of survey questions to be asked to the farmers. Those questions (associated to specific indicators) were structured around 9 thematic modules (Demographic, Climate shocks, Climate services, Livelihood security & financial services, Food security and Climate-smart options; Farm Calculator, Crop calculator and Animal Calculator) and aimed to assess:

- Farmers perceptions on the performance and outcomes of CSA options at farm level
- Farmer's perceived effects of CSA practices implementation on their households livelihoods
- Motivations, enabling/constraining factors and adoptions trends

The CSV Monitoring aims to annually gather evidence on CSA at three different levels:

This instrument will also be critical in informing future prioritization, promotion and scaling up of the most promising, locally and socially relevant CSA options.

The sampling methodology in the CSV monitoring consisted on revisiting (after cheking/updating) the same 140 households of 7 veredas (Wasaka abajo, Aguas amarillas, Guapotalito, Hilipo, La Primavera, Las Veguitas, San Benito) targeted by the 2014 CCAFS Baseline survey, and some additional ones (direct 2017 beneficiaries of CCAFS work). A total of 149 households (29% female headed) and 262 farmers (53% female) were interviewed.

Descriptive results

In this section we present the basic descriptive statistics of the sample population in the monitoring survey in 2018[1] and later elaborate upon the results of adoption of climate smart practices and gender differences therein from the gender survey in 2015 as well as the monitoring survey in 2018.

Socio-economic characteristics of the sample population in the monitoring survey 2018

The sample consists of 117 couple households, that is, both the husband and the wife participated in the survey, and 25 households have only participant.[2] Of these 25 households, in 17 cases women are the household heads and in the other 6 only men head the household. The status of household headship remains undetermined for 2 households. The average age of male household heads is 50.23 years while for female household heads the average age is very similar, 50.29 years. About 86% of the sample belongs to mestizo ethnic group.

The average household size of female-headed units is 4.17, while in couple-households the average number of members is 5.53. Most of these families are agricultural smallholders. The average land size of households headed by women is 2.55 manzanas and in couple-households the average size goes up to 7.45 manzanas with a very high standard deviation of 14.5, which implies stark inequality in land areas cultivated and/or possessed by couple-households. Among the female-heads, only 58% own land and among the couple-households, only 50% have their own land while rest are renting land to cultivate the staple crops, corn and beans. Many of these households also grow some crops in the household patio. On these lands and household patio, the main crops cultivated by the people are beans, vegetables, coffee, cacao, corn, fruits, and in many cases, they implement the practice of agroforestry along with farming the crops. Almost all the households have some varieties of chickens and other poultry animals.

For **most of these households farm production is the main source of food consumption**. Almost 82% of the households reported farm production as the main source and the rest used incomes to purchase foods. Due to variable weather patterns and other physical and economic factors, food insecurity is common in this region and many households face food shortages. In the sample population, around 37.5% of the households lacked food in the four weeks prior to the survey, although it was not a regular phenomenon. Almost 80% these households had to reduce food consumption due to food shortage. About half of the families facing food shortage skipped meals.

Perceptions of climate related events

About 67.44% of the individuals interviewed in the survey reported a reduction in their agricultural income due to an external event. In the following question about the impact of an external event related to climate change, almost 70% of participants reported that in the last 12 months their incomes were affected by events related to climate change. Later, we investigate in

[1] The socio-economic characteristics of the sample population in the baseline survey 2015 are presented in the Twyman et al. 2016.

[2] Given the structure of the survey instrument it is difficult to determine when these households non-couple households or not.

detail which extreme weather events and how each of those affected the well being of the sample households. In table 1, we report sex disaggregated individuals' responses related to the perceptions climate related events.

Table1: Men's and women's perceptions of the effects of climate related events

Event	***Those affected by the event (in percent)***		
	Women (98)	***Men (82)***	***All (180)***
Irregular rains	57.14	46.34	52.22
Drought	12.24	19.51	15.56
Storms/winds	21.43	17.07	19.44
Heavy rains	54.08	65.85	59.44

Note: Number of observations in parentheses. In this case, total number of observations pertains to the cases those reported to have felt the effects of climate-related events.

Of those who have been affected by climate related events, around 52.22% of the individuals reported that in the last 12 months irregular rains in particular affected their farm activity and the income generation activity. Drought, however, was not perceived to be a severely disturbing event by the majority of the respondents. Since the sample population depends on rain-fed agriculture irregularity of rain can be perceived as a serious threat to people's production and income generation activities. Tuma la Dalia due to its location in the dry corridor is particularly affected by the phenomena of El Niño, that is, irregular rains, and not surprisingly more than 50% of the sample population reports this phenomenon affecting their livelihoods. Among other climate related events, people report heavy or torrential rains as a major event affecting farm production and incomes. Heavy rains affected almost 60% of the sample population in the last 12 months. As shown in table 1, more men report the disastrous effects of heavy rains while more women report being affected by irregular rains. The fact that men and women report differently the perceptions of climate-related events could be due to the effects of each event, which are felt differently by men and women. It is more likely that shortage of water caused by irregular rains affect women more due to lack of water availability for household, which may increase their time spent on collecting water. Heavy rains can cause property damages like house roof, animal shelter, and also destroy crops. Since these effects are related men's activities of repairing the infrastructure, and farming, it is likely that more men reported the effects of heavy rains.

People cope with extreme weather events by applying different mechanisms like borrowing money, drawing on savings, reducing consumption including food consumption. In table 2a and 2b, we present some of the coping mechanisms practiced by the sample population during two main climate-related events – heavy rains and irregular rains. These responses reflect the percentage of those who felt the effects of the respective weather events.

Table2a: Men's and women's responses on the coping mechanisms to deal with extreme weather events (irregular rains**)**

	Coping mechanisms practiced as result of irregular rains (in percent)		
	Women (56)	***Men (38)***	***All (94)***
Reduce HH expenses	60.71	63.16	61.70
Sold assets	35.71	50	41.49
Look for new source of income	41.07	47.37	43.62
Borrow money or use savings	32.14	39.47	35.11
Temporary migration	44.64	39.47	42.55
Off-farm work	48.21	36.84	43.62
Rationing or skipping meals	37.50	28.95	34.04

Table2b: Men's and women's responses on the coping mechanisms to deal with extreme weather events (heavy rains)

	Coping mechanisms practiced as result of irregular rains (in percent)		
	Women (53)	***Men (54)***	***All (107)***
Reduce HH expenses	62.26	64.81	63.55
Sold assets	28.30	37.04	32.71
Look for new source of income	47.17	42.59	44.86
Borrow money or use savings	33.96	35.19	34.58
Temporary migration	39.62	46.30	42.96
Off-farm work	37.74	44.44	41.12
Rationing or skipping meals	32.08	25.93	28.97

Note: Number of observations in parentheses. In this case, total number of observations pertains to the cases those reported to have felt the effects of heavy rains.

The results show that the **common mechanisms to cope with the impact of an extreme weather related event is to reduce household expenses and even reduce consumption of food by rationing or skipping meals**. In both climate-related events, we find more women reporting to food rationing than men, even though the question was asked at the household level. This indicates that given women's role in food provisioning, they may sacrifice food consumption so that other household members can attain sufficient consumption levels. The sample population also resorted to selling their assets, borrowing money, looking for new sources of income including off-farm work and temporary migration.

Knowledge and adoption of CSA practices

As pointed out earlier in the paper, Tuma La Dalia is one of the CCAFS sites where different climate smart practices have been implemented by CIAT and CCAFS teams. The practices help farmers build resilience to the effects of climate variability and have been customized to meet the needs of the smallholders in this context. In 2015, the baseline gender survey conducted by CIAT reviewed the state of adoption of different climate smart practices and other traditional adaptation mechanisms. The *practices module* in the survey aimed to collect information on knowledge, sources of information on practices and adoption rates among the participant households. The *practices module* asked questions related to a total of 25 practices. About 13.33%

of the households did not adopt any practice mentioned in the list of 25 practices and around 50% of the households implemented up to 4 practices. Some households are more proactive in implementation of these practices compared to others and we see that in the results whereby around 35% of the household implemented up to 10 practices.

In table 3, we present men's and women's knowledge and adoption of different climate smart and adaptive practices. As shown in the table below, some practices are more known and adopted by the farmers compared to other practices. It is also obvious that there are **gender differences in the knowledge and adoption of these practices.** Overall for all the adaptive practices, **more men have the knowledge and awareness of implementation of these options** except for the practice of improved processing, which could be for the fact that post-production and food processing is mainly women's task. **Except for the practices of reforestation and no burning, all other practices have an adoption rate of less than 50%.** Although the **proportion of women reporting awareness of practice is lower,** when considering the adoption rates, we find that for **practices like agroforestry, live fences, and reforestation, a higher percentage of women report adoption** compared to men. It is possible that agroforestry and reforestation are practices more important for women due to their strong connection with forests and the resources they derive from them.

The monitoring survey implemented in 2018 by the CCAFS team intended to collect information on the state of adoption of 6 specific climate-smart practices promoted in the area: crop diversification in the garden, Perennial crops and diversified livestock systems, No burning and crop residue retention , Protection of water sources on the farm, non-synthetic fertilizers, and new improved varieties resistant to drought. Table 4 presents men's and women's responses on their awareness and adoption of these CSA practices.

Table 3: Men's and women's responses on the knowledge and adoption of climate smart and adaptive practices in the baseline survey 2015

	Proportion of women who have:			Proportion of men who have:		
Practice	**Heard**	**Adopted (of those who have heard)**	**Adopted (of the whole sample)**	**Heard**	**Adopted (of those who have heard)**	**Adopted (of the whole sample)**
Agroforestry	44.27%	81.25%	35.97%	54.81%	59.54%	32.64%
Live fences	53.75%	56.62%	30.43%	81.59%	32.31%	26.36%
Terrace farming	27.67%	15.71%	4.35%	75.31%	11.60%	8.79%
Drainage ditches	26.88%	33.82%	9.09%	58.58%	35.00%	20.50%
Tillage farming	29.64%	16.00%	4.74%	47.70%	28.70%	13.81%
Compost	30.83%	23.08%	7.11%	59.83%	14.69%	8.79%
Mulching	23.32%	54.24%	12.65%	56.90%	66.67%	38.49%
Soil analysis	23.32%	18.64%	4.35%	33.89%	34.94%	12.13%
Intercropping	47.43%	70.25%	33.60%	57.74%	52.90%	30.54%
Crop rotation	50.20%	73.23%	36.76%	62.34%	46.31%	28.87%
Improved varieties	26.48%	43.28%	11.46%	76.57%	51.37%	39.33%
Integrated pest management	33.60%	35.29%	11.86%	44.77%	17.59%	7.95%
Bio-digester	21.74%	1.82%	0.40%	35.15%	0.00%	0.00%
Silvopastoril	14.62%	27.03%	3.95%	18.41%	34.09%	6.28%
Improved livestock	26.88%	16.18%	4.35%	41.42%	13.13%	5.44%
Improved pastures	34.39%	25.29%	8.70%	57.74%	28.26%	16.32%
Pasture rotation	26.48%	29.85%	7.91%	40.17%	30.21%	12.13%
River/canal	34.39%	11.49%	3.95%	52.30%	4.00%	2.09%
Water harvesting	20.16%	0.00%	0.00%	27.62%	3.03%	0.84%
Improved processing	25.32%	43.33%	10.28%	31.20%	15.07%	4.60%
Efficient stove	49.80%	17.46%	8.70%	45.61%	11.93%	5.44%
Seed Selection	33.20%	70.59%	23.72%	76.15%	62.09%	47.28%
Residual treatment	2.37%	0.00%	0.00%	9.62%	13.04%	1.26%
Reforestation	85.38%	78.70%	67.19%	93.72%	61.16%	57.32%
No burning	92.89%	89.79%	83.40%	96.65%	94.37%	91.21%

Table 4: Men's and women's responses on the knowledge and adoption of climate smart and adaptive practices in the monitoring survey 2018

	Proportion of women who have:			Proportion of men who have:		
Practice	**Heard**	**Adopted (of those who have heard)**	**Adopted (of the whole sample)**	**Heard**	**Adopted (of those who have heard)**	**Adopted (of the whole sample)**
Patio crop diversification	66.91%	61.29%	41.01%	70.59%	51.19%	36.13%
Perennial crops & diverse livestock systems	48.20%	67.16%	32.37%	59.66%	57.74%	34.45%
No burning & crop residue retention	93.53%	76.92%	71.94%	95.80%	84.21%	80.67%
Protection of water sources	76.98%	40.18%	30.94%	78.15%	49.46%	38.66%
Non synthetic fertilizer	55.40%	27.27%	15.11%	59.66%	33.80%	20.17%

Improved varieties	51.08%	56.33%	28.78%	64.41%	55.26%	35.59%

According to the monitoring survey in 2018, for all the CSA practices, more than half of the sample population is aware of them. Across all the CSA options, a higher proportion of men report knowledge and awareness of these practices. The practice of **no burning and mulching for plant cover is more than 90% of the participants**. These results show that for some practices like improved varieties of crops resistant to drought and diverse livestock systems, lack of awareness is still problem and it may be inhibiting adoption and implementation of these practices. The implementation of **no burning and** crop residue retention, however, is motivated primarily for the reason of adapting one's practices to climate change and its effects. **More than 50%** of those who have adopted this practice stated their **principal reason as a response to climate change** and to prepare themselves to its effects, as the reason for its adoption. Only 10% reported adoption of no burning and crop residue retention practice because of CCAFS' knowledge dissemination. Again we do not find significant gender difference in the motivation behind adoption of this practice.

Next, we consider the adoption of these practices in the twelve months prior to the survey was conducted. Overall, the adoption rates are very low for the CSA option of improved varieties, only 15% of women and 20% of men reported to have adopted this option. Once again, lower adoption of this practice may be related to lack of awareness about it. Therefore, **we examine the adoption rates for those who are aware of this practice. Nonetheless, the adoption rate of improved varieties is pretty low, less than one-thirds of the sample population.**

The adoption of no burning and crop residue retention CSA option is much higher compared to other CSA practices. It is possible that this practice has been promoted for long time by different organizations and therefore, more and more farmers have come to adopt and implement it. According to the monitoring survey in 2018, more than three-fourths of the sample population is implementing the practice. Similarly, in the baseline survey we found almost 90% of the sample reported adoption of no burning practice.

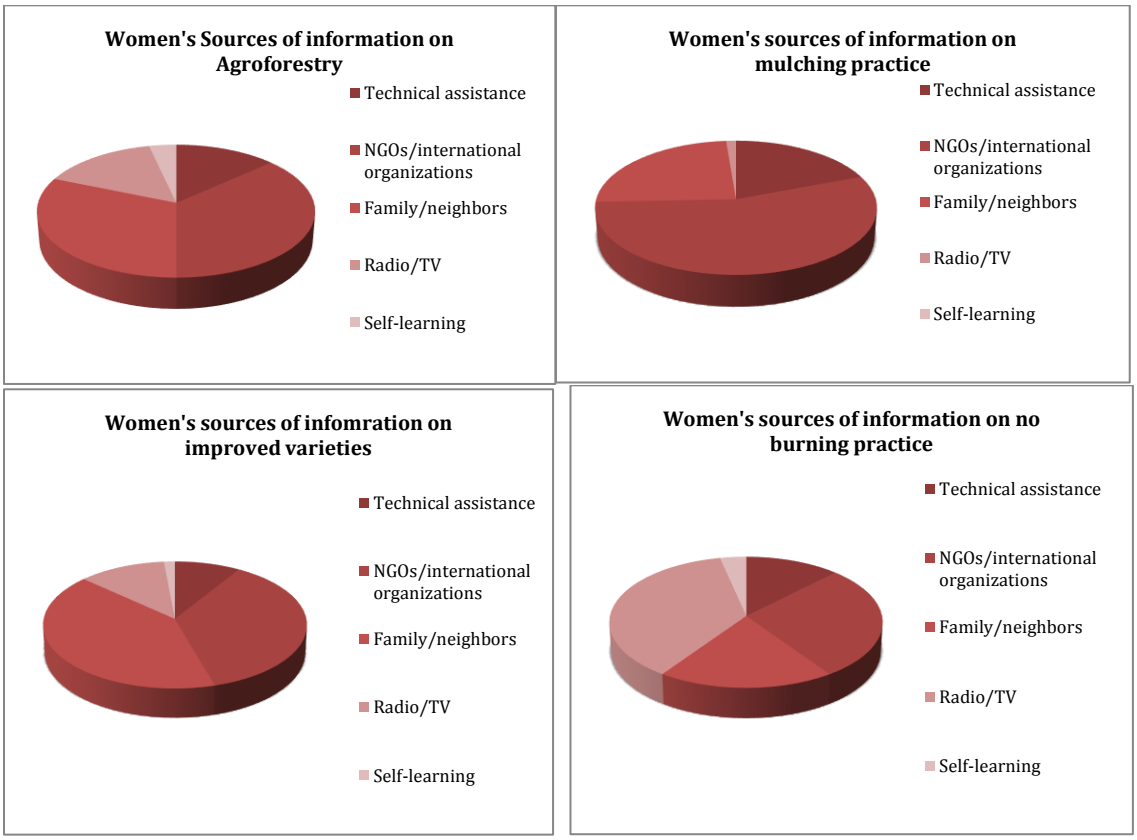
An interesting result from the gender perspective is found in the adoption of CSA option related to garden or patio crop diversification. Overall, 41% of the women in the sample population reported adoption of this practice compared to 36% of men. On considering the sample of those who are aware of this practice, more than 61% of the women reported adoption of patio crop diversification compared to only 51% of men. Garden or patio crops are usually women's responsibility, that is, it is an extended form of women's unpaid work. Given these gender roles, it is no surprise that more women reported adoption of patio crop diversification. Another possible reason for these results is the fact that CCAFS and other rural development organizations are increasingly targeting women to build their capacity in raising garden crops, which helps them diversify food consumption and increase household food security.

The monitoring survey also asked people's motivation to implement the practices. The results suggest that farmers implemented the CSA options for 2 primary reasons – due to previous or future climate change event and because of CCAFS knowledge dissemination. For patio crop diversification, we find that about 27% of those who have adopted this practice did it because of CCAFS' knowledge dissemination and the other 27% stated climate change as reason for adoption of this practice. We do not find significant gender differences in the motivation to implement patio crop diversification.

Sources of information of CSA options

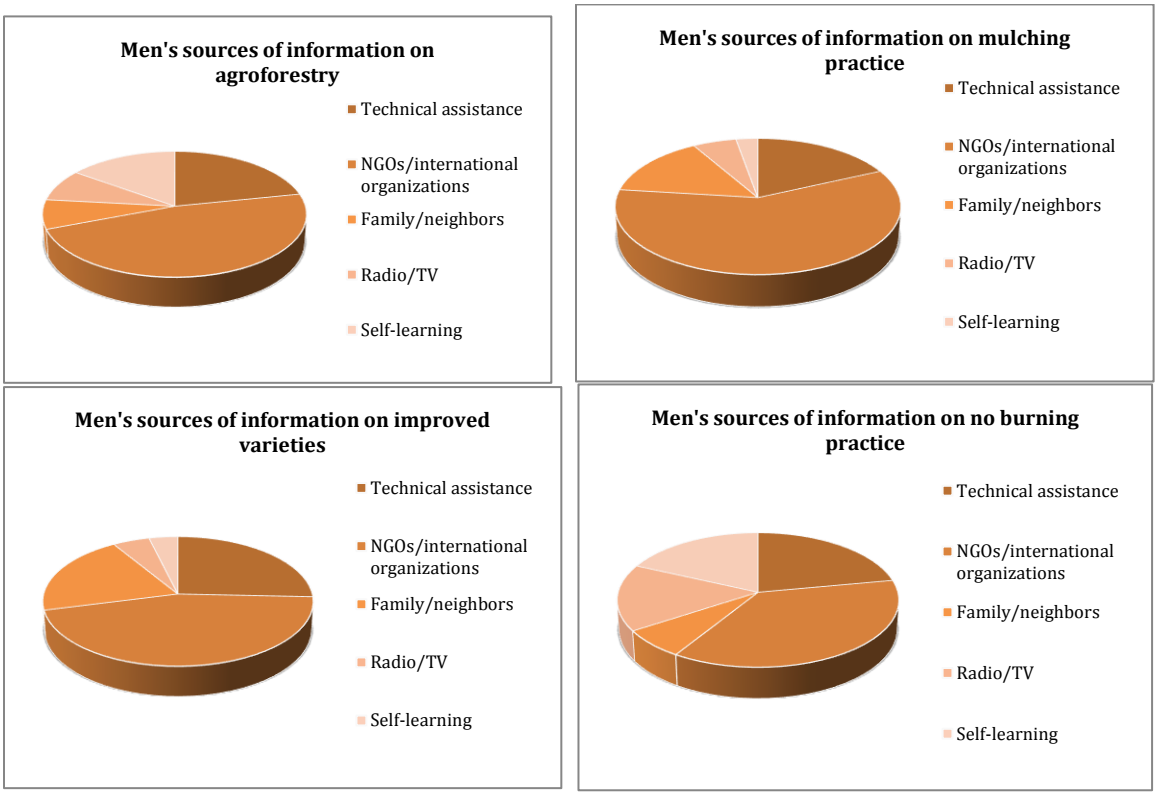
The knowledge and awareness of CSA practices as well as their implementation method is important for actual adoption and maintenance of the practices. Here the role of CCAFS and other local organizations is critical in disseminating the knowledge and in some cases, the start up technology to the farmers. In both the baseline survey 2015 and the monitoring survey 2018, we asked the participants about the sources of information regarding the practices that they have adopted or know the implementation technique of. In figure 1a & 1b, the pie chart presents the distribution of men's and women's sources of information on adoption of different CSA practices using the baseline survey data 2015.[3]

Figure 1a: Women's sources of information on adoption of different CSA practices (from baseline survey data 2015)



[3] We present selected practices in the figure 1. For more information on the sources of information of all the practices, please see table A.1 in appendix A.

Figure 1b: Men's sources of information on adoption of different CSA practices (from baseline survey data 2015)



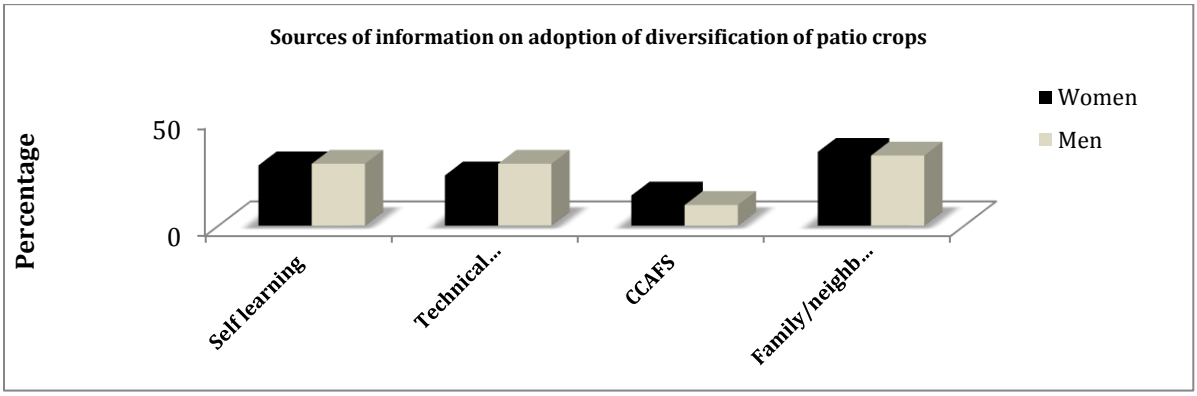
Across all the practices**, two sources of information appear to be most important in dissemination** of adaptive practices - **NGOs and family/neighbors**. Next, diffusion of knowledge through **communication technology**, particularly, radio is another critical source. From figure 1a and 1b, we gather the gender differences in the importance of the sources of information on adoption of adaptive practices. For example, in adoption of agroforestry, for women NGOs and family/neighbors are the principal sources and are equally important. However, for men adoption information of agroforestry comes primarily from NGOs and technical assistance from local government and institutes. In case of no burning practice, for women radio plays an important role in learning of the practice while for men once again NGOs and technical assistance from local government and institutes remain important sources of information. In case of adoption of improved varieties, the only gender difference is observed in source of information coming from family/neighbors, which is the principal source for women and not so in case of men. For the adoption of mulching practice, we do not observe any significant gender differences in the sources of information.

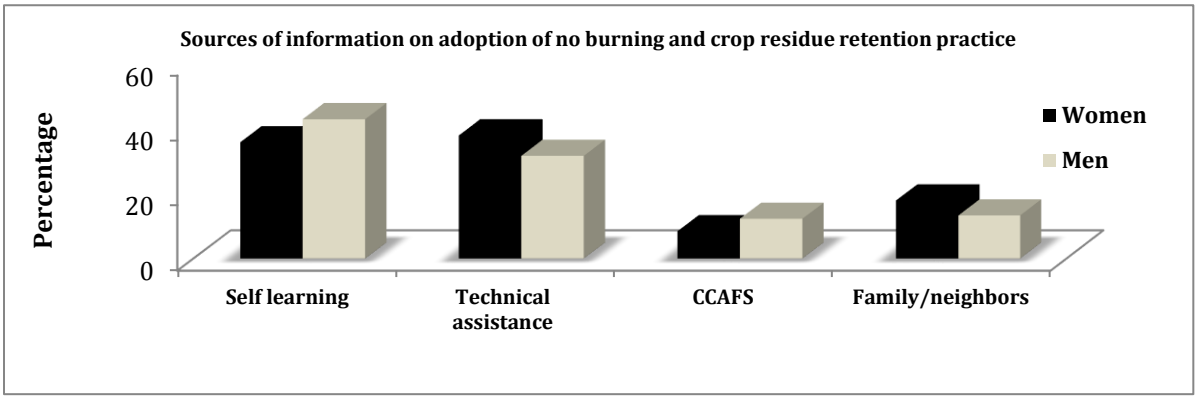
Now, we present men's and women's sources of information on adoption of CSA practices only using the monitoring data 2018 in figure 2. For the CSA option of diversification of patio crops, CCAFS is an important source of information for women more than for men. Women also learned about this CSA practice from family members and neighbors along with self-learning, which could imply using their previous knowledge of garden crops to diversify crops and activities in the patio. Overall for all the CSA options, people reported technical assistance from governmental or NGOs as a major source of information about the practices and their implementation techniques. The

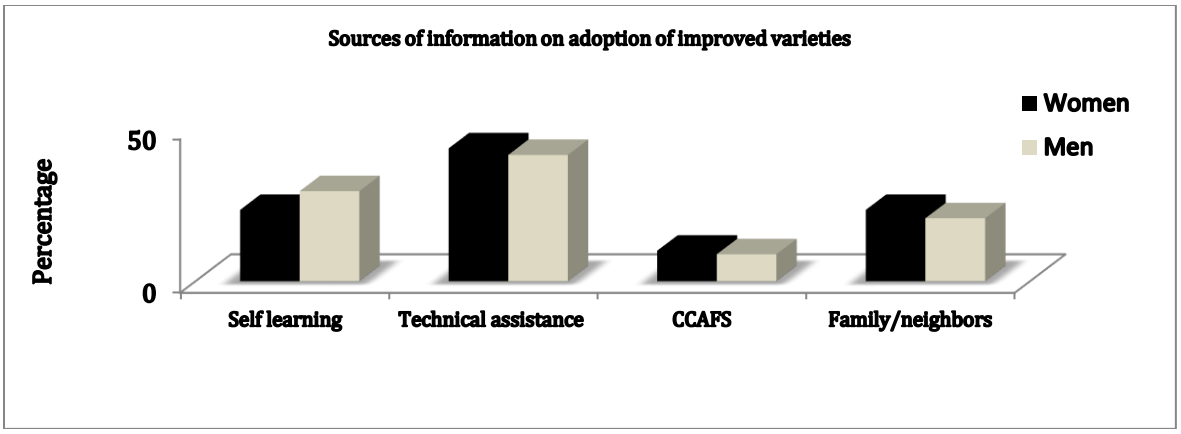
second most important source of information on practices is family members and neighbors, not in case of no burning and crop residue retention practice. The sharing of information between extended family members as well as among the community is common in smallholder societies and this is one of the practices that have been encouraged by CCAFS and other NGOs in order to increase uptake of technology. Although not obvious, it also points to 'doing by seeing' hypothesis. Many times community members start implementing a practice or learn a new one by seeing their neighbors or other family members do well as result of it. The sample population reported self-learning as another source of information on practices and the implementation technique. This category is particularly important for the adoption of patio crop diversification technique and no burning and crop residue retention practice. To some extent, it is understandable why self-learning serves as an important source of information on these two practices due to assimilation of the basics of these practices in the cultural upbringing. For example, girls are often socialized to learn the cultivation of garden crops by their mothers or other female adults in the household. This implies that women have already some knowledge of patio crops and activities.

A consideration of the men's and women's sources of information on CSA and adaptive practices as well as sources of learning the techniques of implementation helps understand what are the best ways to target each group of populations. **Lack of further data on people's preferred sources and the constraints to receive information from different kinds of sources restricts the analyses on how to better reach different groups of populations.**

Figure 2: Sources of information on adoption of different CSA practices (from monitoring data 2018)







Intra-household dynamics in adoption of CSA and adaptive practices

The adoption of CSA and adaptive practices is a strategic decision for the household. Often times, household members involved in agricultural activities and those involved indirectly discuss the possibility of implementing these practices upon learning. **Having a voice and agency in decision-making around strategic decisions of the household can be empowering**. The feminist scholarship emphasizes on developing better methods to understand women's empowerment in agriculture. Therefore, **an analysis of gendered decision-making power in the strategic decisions related to adoption of practices can be a useful method to understand women's empowerment in agriculture.** In this sub-section, we present results of men's and women's involvement in decision-making related to the adoption of different adaptive practices using the two datasets from Tuma La Dalia.

Table 5: Women's responses on their decision-making power in the adoption of adaptive practice according to the baseline survey 2015

Practice	% of adopting households where the woman was involved in the decision related to [PRACTICE]:
Agroforestry	70.69
Live fences	75.93
Terrace farming	57.14
Drainage ditches	63.16
Tillage farming	71.43
Compost	88.24
Mulching	89.47
Soil analysis	63.64
Intercropping	73.08
Crop rotation	72.01
Improved varieties	52.38
Integrated pest management	56.52
Improved processing	68.75
Reforestation	71.91
No burning	66.37

Table 6 shows the different categories of decision-making dynamic for each adaptive practice using the baseline survey data 2015. We present results for selected practices due to missing values in others. Similarly, we do not present the results of men's responses to women's involvement in decision-making related to adoption due to several missing values in the questions related to decision-making. **Overall, the pattern from men's and women's responses show that men understate women's involvement in decision-making related to adoption of practices while women report more joint decision-making**.

Table 6: Men's and Women's responses on their decision-making power in the adoption of CSA practices according to the monitoring survey 2018

Practice	% of women who participated in decision-making related to the [PRACTICE]:	
	Women adopters	Men adopters
Patio crop diversification	92.98% (57)	60.47% (43)
Perennial crops & diverse livestock systems	78.78% (45)	48.78% (41)
No burning & crop residue retention	81% (100)	50% (96)
Protection of water sources	90.7% (43)	63.04% (46)
Non-synthetic fertilizers	90.46% (21)	37.5% (24)
Improved varieties	87.5% (40)	41.86% (43)

Note: Number of observations in parentheses.

In table 6, we show that in most of the practices already adopted, **a considerable proportion of women were involved in the decision-making dynamic.** For example, in the implementation of agroforestry, of the 58 households that implemented it, in 70.69% of the households women were involved in the decision-making process.

Now we analyze the results from the monitoring survey 2018 to understand the decision-making patterns in adoption. Table 6 presents the responses of men and women on their decision-making power in the adoption of different CSA practices. We present the responses of men and women separately in order to capture their own perception of their role in decision-making dynamics of the household. As shown in the literature, often men underestimate women's role in agricultural decisions (Anderson 2016, Alwang 2017, Arora and Twyman 2018), we consider men's opinion of women's decision-making role in adoption in addition to women's own opinion.

Similar to the results observed in the intra-household decision-making literature, we find that women report joint decision-making with them being involved in the decisions related to all the CSA practices. **Between 80-90% of women adopters reported that were involved in the decision related to adoption of the CSA practices. Men, however, underestimate women's role in decision-making. Up to 63% of men adopters, with a variation of 37.5% to 63.5% across practices, reported joint decision-making or women's involvement in adoption of practices.** There are several possible reasons for this discrepancy in the reporting of decision-making perception of men and women. The **concept of decision-making could be different for the participants**. Oftentimes, men farmers report that **they only inform the wife and do not consider that as a joint decision while the woman considers that she has been involved in the decision**. So it is probable that lack of understanding of the local or contextual concept of decision-making causes the discrepancy in the responses. Further research is **required to refine the**

methodological approach to understanding decision-making dynamics in agricultural activities and CSA adoption.

Discussion

In this paper we present gender disaggregated descriptive statistics of CSA adoption trends including farmers' knowledge of practices and their implementation technique, the sources from which they learn of new practices and the intra-household dynamics in decision-making related to CSA adoption. We summarize the main results of the paper under four main heading as follows:

- ***Knowledge & awareness*** – The results from the baseline survey 2015 show that there are gender differences in the knowledge and awareness of the adaptive practices. Overall, fewer women have the knowledge of adaptive practices. Similarly in the monitoring survey 2018, we find a gender gap in the knowledge of CSA practices. However, the gap is smaller in the 2018 results. It is difficult to compare the two results due to differences in the survey objectives and participants; however, both results indicate that there is a lack of knowledge of CSA and other adaptive practices among women. The main implication of these results is to target more women in dissemination of information about the practices and the implementation technique. Therefore, it is critical to first understand women's role in different agricultural activities, their needs and preferences for CSA and other options and most importantly women's preferred sources of information in order to facilitate greater uptake of CSA technology by women.

- ***Sources of knowledge*** **-** Using the two datasets, we analyze men's and women's sources of information on CSA and adaptive practices. We find some differences in the sources of information of the CSA practices between men and women. Mostly, women receive information from friends and neighbors. The second most common source of information for women is communication technology particularly radio. According to the monitoring survey 2018, we find that technical assistance from the government or local organizations is the most common source of information for both men and women, except for the practice of patio crop diversification whereby for women self learning and information from neighbors is critical. Although not obvious, the 'learning by seeing' hypothesis could motivate the self-learning aspect. Many times community members start implementing a practice or learn a new one by seeing their neighbors or other family members do well as result of it. From a gender perspective, it is important to understand the sources preferred by women in order to facilitate technology and knowledge dissemination though those sources for a greater adoption of CSA options by women. The investigation of the sources of information on CSA and adaptive practices as well as sources of learning the techniques of implementation is a way to understand the preferred sources of men and women or it could point to the weaknesses of some sources in reaching a particular group. In future it is recommended to consider people's preferred sources and the constraints to receive information from different kinds of sources in order to better reach different groups of populations.

- ***Adoption*** – We consider adoption rates among the whole sample and among those who has knowledge of the practices. Overall, we find that the adoption rates in 2015 are very low for most of the practices except reforestation and no burning practices. Considering

the monitoring data in 2018, the results are similar, that is, only the no burning and crop compost of crop practice has high adoption rates in the sample population while other practices have low adoption rates. Often lack of knowledge or information of practices inhibits adoption. Therefore, we analyze the adoption rates among those who reported to have heard of the practices in the CSA village. We find the adoption rates to be higher, however, for some of the practices it is still very low. For example, use of compost or use of improved varieties, both practices have a very low adoption rate in 2015. This is suggestive of other constraints besides knowledge inhibiting adoption of these practices. In the monitoring survey, we find similar results for the adoption of improved varieties. The adoption rate among those who have heard of the practice is around 50% for both men and women. The rate is even lower for adoption of non-synthetic fertilizers. Due to data constraints, we are unable to analyze the inhibiting factors to adoption of these practices. However, this is a recommendation for collection information on facilitating and constraining factors to adoption of CSA practices using both quantitative data and complementing it with qualitative data for an in-depth analysis.

The responses for adoption have been collected and analyzed at the individual level, that is, separately for men and women. In several cases, we find discrepancy in the responses of men and women from the same household. For example, the husband reported adoption of improved variety seeds in the household farm while the woman's response is contrary to his. It is possible that the woman is not aware of her husband implementing this technology on the family farm. This kind of data complicates the analysis and makes it very difficult to calculate household level adoption rates. We recommend two different options for a better analysis of adoption rates considering the gendered aspects of it. 1. If the objective is to analyze adoption rates at the household level, the question must be asked at the household to only one person in the household. It is important to select this one respondent carefully by asking in the beginning that who is more knowledgeable of certain practices on the farm. In this way, we collect adoption information at the household level. From here, it is possible to get into intra-household analysis of adoption related decisions, and labor and resource demand. For example, among adopting households both the man and the woman can be interviewed to record their individual perceptions on the process of adoption (facilitating or constraining factors and decision-making) and the effects of CSA adoption. Similarly, among the non-adopting households, we can ask at the individual level, perceived constraints to CSA adoption. 2. The second option is to consider individual level adoption whereby during data collection the questions on adoption or implementation of practices as well as on participation, benefits and impacts are asked at the individual level (which is currently the case) but as well as asked for the individual (personally). Here the question could be phrased, "did you implement CSA practice in your household farm?" It would still be important to consider what is happening at the household level in order to avoid double counting. For example, if both the man and the woman respond that they implemented a CSA practice on the household farm, it must be counted once. Additionally, we can ask a question on if they implemented the practice separately on their own farm (different from the household farm) to capture individual level differences. The main drawback of the individual approach is that it may not be a relevant question in certain contexts. For example, in some countries from South-East Asia, it is observed that under some cultural contexts, households jointly undertake or decide upon farm related agricultural practices.

- ***Intra-household dynamics in adoption of practices*** – In this section, we analyze the intra-household decision-making aspect of adoption of CSA and adaptive practices. In both datasets, we find discrepancy in men's and women's responses to their power in decision-making related to adoption of CSA and adaptive practices. Women reported joint decision-making or their involvement in adoption decisions while men seems to underestimate their role. This is concurrent with the existing literature on intra-household decision-making in agriculture. There is a lot of debate on how to resolve the issue with discrepancy in the reporting of decision-making power by men and women. First of all, it is important to understand the local meanings and processes of decision-making for the context being studied. This will be helpful to rephrase or adjust the survey instruments to capture the true meaning of intra-household decision-making dynamic. Second, it would be more valuable to understand men's and women's incentives to participate in the decisions related to adoption of practices. Women may not benefit from a practice and therefore, may choose to not participate in the decisions related to the practice. This, however, does not imply that she is not empowered. This has an implication for the monitoring of CSA practices and its impact on empowerment. The decision-making aspect of adoption also points at gendered power distribution in the household. It is critical to consider the labor and monetary benefits and costs of adoption along with the decision-making aspect of who has the power to make decisions on adoption or implementation of practices.

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