GENDER-BASED BARRIERS HINDERING THE UPTAKE OF CSA AND CIS TECHNOLOGIES IN RICE PRODUCTION SYSTEMS IN MALI

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Fatoumata Diabate, Sarah Eissler, Gaudiose Mujawamariya, Elizabeth Bryan, Elliott Dossou-Yovo, Claudia Ringler, Aminou Arouna

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Photos

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ABOUT AICCRA

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Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) is a project that helps deliver a climate-smart African future driven by science and innovation in agriculture. It is led by the Alliance of Bioversity International and CIAT and supported by a grant from the International Development Association (IDA) of the World Bank. Explore our work at aiccra.cgiar.org

ABSTRACT

Women face significant challenges to adapt to the climate change effect in rice farming, due to socio-cultural norms, and unequal access to agricultural resources, climate-adapted technologies, and climate information services. This study explores the gendered constraints and opportunities in rice production in Mali, with the aims to identify enabling mechanisms that support women in accessing and using these climate smart technologies and practices. It is based on qualitative data collected from 12 circles in five rice growing regions in Mali (Ségou, Sikasso, Koulikoro, Dioila, and San) among 35 key informant interviews (KIIs) held with 259 respondents (171 men and 88 women), and 40 sex-disaggregated focus group discussions (FGDs), that engaged 348 farmers (180 men and 168 women). Findings reveal that barriers to adoption of CSA and CIS technologies include socio-cultural norms, financial barriers, limited training and literacy, as well as differences in access to and control over agricultural resources; women experience additional challenge such as limited access to farmland, reliance on male counterparts for equipment, and restricted access to credit. The study recommends gender-inclusive strategies including delivering information in local languages, expanding training opportunities for farmers, and improving women's access to credit. Awareness campaigns on climate-resilient crop varieties and sustainable practices can increase adoption and build women resilience in rice-based farming systems.

Keywords
Climate change, gender, Mali, CSA and CIS technologies, qualitative methods

The authors

Fatoumata Diabate is a Research Assistant in Gender and Social Inclusion under AICCRA, AfricaRice. Email: F.Diabate@cgiar.org

Sarah Eissler is an independent consultant.

Gaudiose Mujawamariya is Rice value chain field expert and Gender focal point at AfricaRice

Elliott Dossou-Yovo is an agricultural specialist for climate change Research, AfricaRice.

Elizabeth Bryan is a Research Fellow, Natural Resources and Resilience Unit, IFPRI

Claudia Ringler is the Director, Natural Resources and Resilience Unit, IFPRI.

Aminou Arouna, Policy, Innovation Systems and Impact Assessment Program Leader-Impact Assessment Economist Research, AfricaRice

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ACRONYMS

AfricaRice	Africa Rice Center (Centre du Riz pour l'Afrique)
AICCRA	Accelerating Impacts of CGIAR Climate Research for Africa
CSA	Climate Smart Agriculture
CIS	Climate Information Services
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussions
GDP	Gross Domestic Product
IFPRI	International Food Policy Research Institute

INTRODUCTION

Four main environments categorize Mali's rice production – irrigated lowland, rainfed lowland, rainfed upland and submergence system— each with their own cropping systems. Women play an important role in rice and associated crop and animal production in the different growing environments. Yet, they face greater constraints in responding to the negative impacts of climate change due to socio-cultural norms and differences in access to resources, improved technologies, and services. One of the objectives of AICCRA-Mali is to better understand the gendered constraints and opportunities for managing climate risk and promoting broad-scale Climate Smart Agricultural (CSA) technologies and access to Climate Information Services (CIS), including for marginalized groups. This research study broadly aims to assess these constraints and opportunities in the context of rice production in Mali. The results of this study will enable AICCRA-Mali to identify and make accessible CSA/CIS technology packages for sustainable scaling with identified benefits for rural women and men. And these findings will be used to inform the design of CSA and CIS packages to be integrated into gender-sensitive climate-informed advisory services.

To better understand gender roles in rice-based systems in Mali and identify opportunities for women to contribute to CSA technologies and practices, qualitative data were collected from 20 localities distributed across 12 circles within 5 regions in Mali. This study contributes to understand gender-based perceptions of climate change and its impacts, and to identify barriers and opportunities women and youth face in accessing and adopting CSA and CIS technologies and their enabling mechanisms. This research aims to broadly address the following objectives:

- Understand gendered patterns and divisions of labor in agriculture in Mali;
- Assess influence of climate change on farming systems and implications on gender roles;
- Explore gendered perceptions of climate change and women's and youth preferences and needs for CSA and CIS technologies;
- Identify gender-based barriers and incentive mechanisms for CSA and CIS adoption by women and youth.

Background on Rice Production in Mali

Mali is one of the least developed countries with an economy that relies heavily on cereal production. Rice production alone contributes around five percent of the country's Gross Domestic Product (GDP) and represents approximately 12 percent of West Africa's rice production (FAO, 2022). Although domestic rice production increased between 2000 and 2020, the gains were not enough to keep pace with local demand, and about 15 percent of rice sold on the national market is imported (AICCRA, 2023).

Moreover, Mali faces multiple vulnerabilities to climate variability and change. Climate projections suggest that average temperatures could increase approximately by 1°C by the 2030s and by 2–3°C by the 2060s, compared with a 1990 baseline, with an uncertain trend in rainfall. Even if rainfall does not decrease, crop available soil moisture would likely decrease due to increased evapotranspiration caused by higher temperatures and some of the current areas for crop production may become unsuitable. Rice yields are projected to decrease by about 30 percent by 2080 (compared to a 2000 baseline) in Mali, with even higher rice yield reductions in irrigated systems, which contribute 62 percent to total rice production.

producers' participation in cooperatives (Sanogo et al. 2023). Diallo and Dossou-Yovo (2023) also found that participation in social groups, along with experience with rice farming, were key determinants for women producers' willingness-to-pay for climate information services (CIS), whereas determinants for men producers was access to trainings and radio.

Nexus of Climate Change, Gender, and Rice Production

Rice production is an important economic activity in Mali and is vulnerable to effects of climate variability and change. Women play an important role in all aspects of rice production, managing essential tasks such as planting, weeding, harvesting, processing, and parboiling (Mujawamariya et al., 2023). Despite their key role in rice production activities, women in Mali face disproportionate barriers to accessing key resources to fully benefit from their participation and to withstand the impacts of climate change. Such constraints women face includes limited access to land, credit, and technologies compared to their male counterparts. Women also face normative barriers, which limit their decision-making influence and power, freedom of movement, and time-use agency, and all of which further limits their ability to fully benefit from their participation in rice production (Mujawamariya et al., 2023). In addition to these existing barriers, the impacts of climate change pose additional stressors on men and women rice producers. In particular, women producers face disproportionate challenges to accessing or controlling necessary resources in order to strengthen their own resilience in the face of climatic variability. New technologies and practices aimed at strengthening food security and reducing poverty in response to climate change – i.e., climate smart agriculture (CSA) – often are not delivered in ways that accommodate for gender-based needs to facilitate adoption (Sanogo et al., 2023). Factors such as access to land, land tenure, literacy, poverty, infrastructure availability, income, and others contribute to how men and women may be able to adopt new or better practices and technologies. Sanogo et al. (2023) found in Mali that on average, men producers had higher rice yields than women. They attributed this difference to men being more able to access loans and agricultural inputs to reinvest into their rice production compared to women, meaning that women producers were less to purchase and implement new practices or inputs that would improve their rice plots. These findings were like studies conducted elsewhere in West Africa, highlighting that women's disproportionate access to key resources limits their ability to adopt new technologies or practices that would strengthen their production systems compared to men (Partey et al., 2020).

However, Sanogo et al. (2023) highlighted key CSA technologies and practices that were adopted by both men and women rice producers and those that were less likely to be adopted. For example, women producers were less likely to adopt new practices that required extensive physical effort or high costs, such as live fences. Women producers were also less likely to adopt new tree

varieties due to land tenure issues – they couldn't plant new trees on land they didn't own – as well as environmental issues – as new trees would invite new species of birds that could damage the crop. Both men and women were likely to adopt new seed varietals, which was attributed to producers' participation in cooperatives (Sanogo et al. 2023). Diallo and Dossou-Yovo (2023) also found that participation in social groups, along with experience with rice farming, were key determinants for women producers' willingness-to-pay for climate information services (CIS), whereas determinants for men producers was access to trainings and radio.

METHODS

Training of the Qualitative Research Team

Prior to the deployment of data collection team in the field, we initiated a three-days training to equip the facilitators with the required background knowledge and skills including the methodology and ethics of qualitative data collection. This training covered all technical terms and reviewed translation of key terms in the local language to facilitate implementation of the interview tools. Five participants attended this training, four in person and one remotely. The training was prepared and implemented by the Gender team of AfricaRice.

The research team was divided into two small teams, one with women and one with men, consisting of one notetaker and one interviewer each. We organized in a way that the women research team interviewed the women participants whereas the men's team interviewed men participants. The research team had the following expertise: gender specialist, agronomist, and social workers experienced in facilitating focus group discussions (FGD). The research team was fluent in French and Bambara to facilitate primary data collection. In the field, we collaborated with agricultural extension agents, technicians, and focal points of AICCRA Mali to facilitate the organization of the study. This consisted of identifying and selecting respondents who met the criteria for targeting participants.

Qualitative methods

Two methods of qualitative data collection were employed. First, we conducted key informant interviews (KIIs) to collect targeted information about the respective communities. The KIIs were carried out as an entry point into each village. We targeted village leaders, village elders and/or other persons

involved in the leadership positions in different activities (cooperatives leaders or other farmers' groups) to conduct KIIs. One to two KIIs were held in each village. In some cases, KIIs were conducted as small group interviews, and in others, they were conducted individually.

Next, we conducted three types of sex disaggregated FGDs with men or women farmers active in agriculture and livestock in each village. We anticipated each FGD to include approximately six to eight individuals, but in some cases, up to 12 participants joined an FGD. Each type of FGD covered specific topics, as presented in Table 1.

Table 1. Summary of FGDs conducted

FGD	Type of Participants	Type of Information Collected
1	4 to 5 men and 4 to 5 women who are active in agriculture and livestock in the respective village	Gendered roles in farming systems using a gender-based seasonality patterns tool, perceptions of the experience and impact of climate change on agricultural activities and livelihoods
2	6 to 8 men and 6 to 8 women who are active in agriculture and livestock in the respective village	Gendered perceptions of climate change and its influences, and women's and youth's preferences and needs for CSA and CIS technology adoption
3	6 to 8 men and 6 to 8 women who are active in agriculture and livestock in the respective village	Gendered perceptions and descriptions of barriers and incentive mechanisms for CSA and CIS adoption by women and youth

The FGDs involved leaders of farmers groups, farmers and technicians and agricultural agents.

All the KIIs and FGDs were conducted in Bambara, which is spoken by most of the population. The KIIs and FGDs were audio recorded with the participants' consent and were transcribed in French. The final interview guides are available in English upon request from the authors.

Sampling

Study Area

The present study was conducted in 20 localities within five regions across Mali (Ségou, Sikasso, Koulikoro, Dioila, and San) where AICCRA implements its activities. Mali, a landlocked nation in west Africa, has a current population of approximately 23.7 million persons, according to a recent UNFPA data.[1] The same report of the UNFPA (2024) provided that the desert or semi desert covers about 65 percent of Mali's total area (1,240, 192 square kilometers).

[1] UNFPA. 2024. World Population Dashboard: Mali. https://www.unfpa.org/data/world-population/ML

The economy of Mali is largely based upon agriculture and livestock, with a mostly rural population engaged in subsistence agriculture. Below we present specific details about each region included in this study.

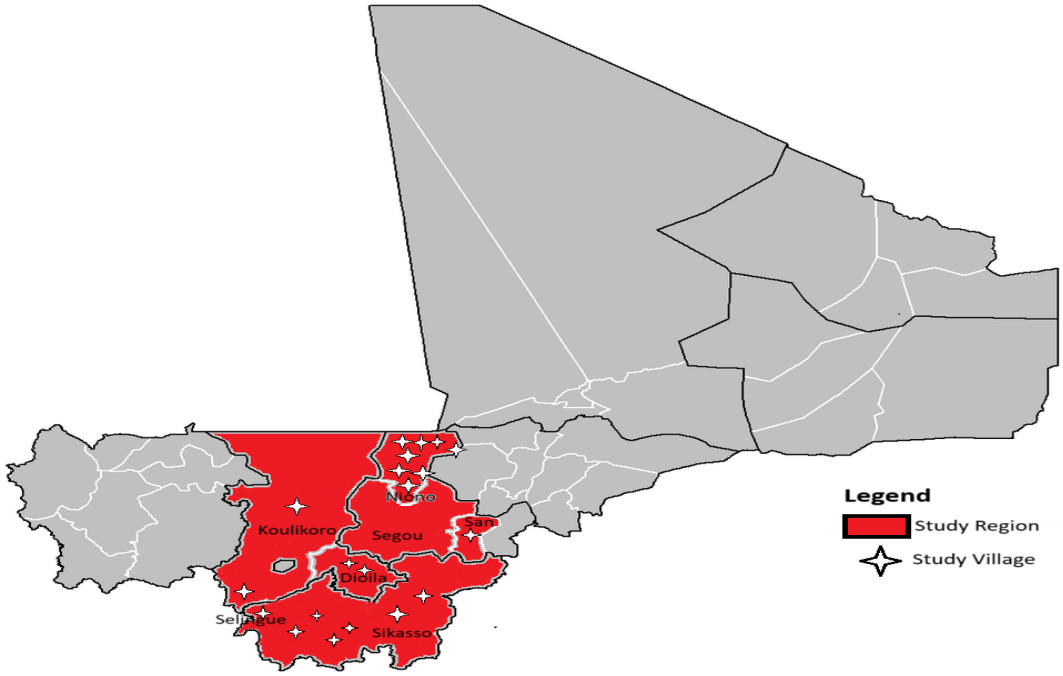

Table 2. Summary of the description of the Regions included in the study

Region	Total Population	Main Economic Activities	Main crops	Environmental Characteristics	Included Localities
Segou	3.3 million	agriculture, livestock, trade and fishing.	Maize, millet, Sorghum, groudnut, Rice, Cowpea	The Ségou region covers an area of nearly 62,000 km². The region has an agro-pastoral vocation, and its population is essentially rural. The climate is divided in two, the north being of the Sahelian type, and the south of the Sudanian type. It experiences different annual rainfall regimes of 200 to 400 mm in the far north, 400 to 600 mm in northern Niger and 600 to 800 in the south (Jean-Michel SOURISSEAU, and al, 2016)[2].	Dioro, N'gara, N'gakoro, Baraoueli-Boidiè, Ke macina, M'bewani Heremakono, N6 Niessoumana, Kolongo.

[2] Jean-Michel SOURISSEAU, and al, 2016. Diagnostic territorial de la région de Ségou au Mali

Sikasso	3.3 million	Agriculture, livestock, artisanal gold mining	Maize, Millet, Sorghum, Cotton, Potato, Rice	The climate is of the Sudanian tropical type, subdivided into two climatic groups: the humid Sudanian zone and the Guinean zone. It had an average rainfall (700-1,500 mm / year). The average temperature is 27 °C (GoM, 2014)[3].	Siramana, Loutana, Lobougoula, Blendio, Ifola, and Finkolo Ganadougou
Koulikoro	3.7 million	Agriculture remains the main activity and employs more than 80% of the population.	Millet, Sorghum, Rice, Maize, Groundnut and Cowpea,	The region is irrigated by several rivers, including the Niger, Baoulé, Sankarani, Baogé, Bani and Bafing. The climate of the region's south has the high rainfall typical of the Sudan, while north of the Kita-Bamako axis, it tends to a Sahelian aridity.	Baguineda, Maninkoura/ Figuira
Dioila	0.7 million	Agriculture, Fishing and livestock	Millet, Sorghum, Maize, Cotton, and Groundnut	The region is traversed by three rivers—the Bagoé, the Banifing, and the Baoulé—and their multiple affluents.	Beleko and Kle
San	0.8 million	Agriculture, animal husbandry, Fishing, Trade, gathering and handicrafts	Millet, Sorghum, Fonio, Maize, Rice	It is spatially wedged between the Bani River and the other neighboring rural municipalities. In this region, where the altitudes vary between 275 and 300 m, the city is located at 4.9 west longitude and 13.3 north latitude.	San

[3] Gouvernement de Mali (2014). Commissariat à la Sécurité Alimentaire de la Région de Sikasso Synthèse Régional. 24-36.

Participant Selection

In total, we conducted 35 KIIs with 259 respondents (171 men and 88 women). The key informants were village leaders, village elders and/or other persons involved in the leadership positions in different activities (e.g. extension agents, farmer's groups' leaders, etc.), three to five persons were interviewed individually or as a large group to obtain complete information about the village. Some KII exceeded the instructed numbers, since participants would voluntarily join the interviews without being invited and could not be excluded away (researchers couldn't control that).

Furthermore, we conducted 40 FGDs, evenly distributed between men and women in each locality. A total of 348 farmers (180 men and 168 women) participated in the FGDs. Each FGD included between 6 and 12 individuals, depending on the availability of producers to participate. Generally, the focal points[4] of AICCRA in each locality were responsible for selecting and inviting participants, based on set criteria of leadership roles in the community[5]. FDGs were conducted in a sex-disaggregated manner, i.e. discussions were held separately between men and women. In each locality, a random choice of the type of focus group discussions to be implemented among the three types of FGDs presented in Table 3.

Table 3. Summary of KIIs and FGDs sample by locality

N°	Locality	Number KIIs	Number of KIIs Participant		Numbers FGDs	Numbers of FGD Participant	
			Male	Female		Male	Female
1	Baguineda	2	4	2	2	6	8
2	Selingue-Dialacoro	1	8	0	2	8	9
3	Maninkoura/ Figuira	1	10	0	2	11	8
4	Siramana	1	8	0	2	8	9
5	Ifola	1	11	0	2	11	8
6	Finkolo Ganadougou	1	5	0	2	7	7
7	Blendio	1	7	0	2	7	8
8	Lobougoula	2	6	9	2	6	9

[4] Focal points serve as leaders of AICCRA activities in each intervention area. They are nominated by AICCRA team in order to facilitate the organization of the project activities

5 Village leaders, village elders, extension agents, farmers groups leaders, etc.); group of women and men who are active in agriculture and livestock; Farmers' representatives and local farmers being women.

9	Loutana	2	11	8	2	11	12
10	San	2	8	1	2	8	7
11	Baraoueli-Boidie	2	12	1	2	12	8
12	Ke Macina	2	8	6	2	8	6
13	Kolongo-Nayo	2	8	8	2	12	8
14	Dioro-Babougou	2	10	7	2	10	7
15	Niono-N6	2	9	8	2	9	8
16	M'bewani-Heremakono	2	11	8	2	11	8
17	N'gakoro	2	9	9	2	9	9
18	N'gara	2	8	8	2	8	12
19	Beleko-Missirila	2	9	7	2	9	8
20	Kle	3	9	6	2	9	9
TOTAL		**35**	**171**	**88**	**40**	**180**	**168**

Data Collection, Management, and Analysis

The data collection was held between January to July 2023. All data collection activities were conducted in person. With informed consent, all interviews and FGDs were audio recorded and were transcribed verbatim mostly in Bambara, the first language and translated into French. All transcripts were used in the analysis. One author developed a codebook inclusive of deductive and inductive themes. This codebook guided the thematic analysis of the transcripts using Atlas.ti software. Two other authors then interpreted the data to identify emergent themes and patterns within the data.

Limitations

The present qualitative study has been designed to assess the influence of climate change on farming systems and implications on gender roles in Mali. There was clarity on the criteria for participating in both FGDs and KIIs. Despite our efforts to comply with the set criteria, we couldn't violate the social and traditional norms, which do not allow us to push back a participant who voluntarily invites him/herself into the ongoing discussions. Thus, we consider this inability as a limitation.

Ethics

This study was approved by IFPRI's Institutional Review Board (IRB). Prior to beginning any of the interviews or FGDs, the interviewer read a statement of voluntary consent to inform each respondent of the research process and to seek their informed consent to participate and to record the interview or FGD. All participants provided oral consent to participate and have the interview or

FGD recorded. Participants received approximately 5 USD as a token for their participation.

RESULTS

Gendered patterns and divisions of labor of agricultural activities

In this section, we present the results, which help to explain how men, women, and youth participate in agricultural activities and highlight the difference where required. The study revealed the reason and interest in the cultivation of specific crop by women, and men as well as the associated normative expectations. The division of crops among women and men vary from regions. In addition, some crops are grown as cash crops whereas others are cultivated for consumption. A detailed gendered crops production in different regions of study is presented in Table A1 in Appendix whereas Table 4 illustrates the general gendered engagement in agriculture.

Table 4. Men and women farmers' engagement in farming

Crops		**Men**			**Women**		
		Level of engagement	**Rationale**	**Approach**	**Level of engagement**	**Rationale**	**Approach**
Cash crops	Cotton, groundnut	Priority: meet financial requirements of the family	Required investment is available: bigger size lands, ploughing equipment, inputs like fertilizers, herbicides, insecticides and labor	men enjoy the support of their wives and adult children in farming activities	Grow in small quantity, less numerous	Limited options on the land selection; Time poverty: Engagement in reproductive tasks; Lack financial resources to purchase inputs	Farming is an off-time job;
	onion, chili				Sold	majority of women can access to land after rice harvesting	
Food crops	Rice, Potato, Sweet	Grow crops that require more financial	Financial requirement	Farming is a social	Home consumption;	Affordable investment, ability to	Women play a supporting

	Potato, Maize, Millet, Sorghum, Bean, Fonio	investment (e.g. potato)		responsibility.	sold when food diminishes	meet consumption and household needs	and backup role

Generally, the factors influencing the farming activities are gendered. On the one hand, men are privileged in the choice of land in terms of quality and size; as owner of the farming equipment, they start with the preparation of their lands and they are the main interlocutors of partners and state agencies, which provide them with subsidized agricultural inputs. On the other hand, unlike men, women have smaller-sized lands which are of poorer quality, they have organizational problems to access subsidized fertilizers, their plots are not always listed and are not always grouped together. To generate extra income, women play extra efforts to generate income through off-time activities and agricultural related work like transplanting in group, gathering, weeding, winnowing and alike.

Land and finance are the key determinants of growing crops. It is worth noting that cultivation of some crops like cotton and potatoes require more financial investment, which contribute to less engagement of women in those specific areas. Access to land was indicated. A participant of women FGD in Lobougoula, Sikasso declared that "*We don't have the land for cotton cultivation. Most of our lands are on savannah dominated zones. Even the men who farm there, it's the women who weed for them. They don't like to go down in the water. In the past period, they used to go there, but now they don't like it"* this point out that the lack of access of the quality of land exclude women in cotton cultivation. The same limitations are observed in rice farming, either in Sikasso region where rice is considered as women's crop grown in rainfed lowland and upland ecologies or in Ségou where rice is grown in irrigated production system.

"Women do not grow rice much due to lack of rice farmland because it is men who allocate them. In addition, women do not have enough means to rent developed land. The men take charge of the family and use their rice for family food, while the women sell what they grow.". **Men's KII in Dioro, region of Ségou.** This statement highlights the difficulties women face in gaining access to developed land, given that distribution is entirely male-dominated, and is

compounded by a lack of financial resources which explains why women are rarely independent rice producers in irrigated areas.

To alleviate these limits, although women are not farms owner, after rice harvesting, they rent or borrow men's plots for onion production. Onion is hence both a cash and food crop for women in the said region. *« No, they do not cultivate in their own plots. Men lend them the plots to cultivate for a while. They often help men in the fields".* KII of men in M'bewani, Ségou.

Besides, groundnut can be considered as men's crop in some areas of Ségou region like Kolongo, Baroueli, N'gara while it might be for women in Sikasso, Koulikoro, and Dioila." *Yes. However, they are less numerous in groundnut production. It's just for a small amount, what you can see for yourself in your groundnut field. Otherwise, it is a culture mainly practiced by men",* FGD women N'gara. Another woman from an FGD in Niono, Ségou similarly shared that "*women and men produce different crops; however, we help men in their crops production*". These testimonies highlight women's involvement in agriculture in supporting men's crops as well as their own, and seemingly have to prioritize the men's farms in rural areas of Mali. However, they do not have agency in decision making or control over those fields/crops or incomes.

The participation of women and men in agricultural production

The study clearly revealed that men and women are both involved in agricultural activities for all the crops produced in the study areas. In spite of this differential in crop production, women use their labor force in family farm activities. In addition to their crops, they are also more involved in men's crops activities. A woman said during female FGD in Lobougoula, Sikasso.

> "*Currently, it's not easy to say, otherwise practically, they're just making tea and no longer last in the fields work. They just work a little bit and then go home. They don't have the courage to say that it is women who carried out the activities of all the crops production during the rainy season. However, in some families it is organized and divided. For example, in some families, women participate in the work with men in*

their fields for two or three days per week and they spend the leftovers of the other days in their own field. For others, it is only on Friday that they are allowed to work in their own fields. In short, we are the ones who do everything along with our children."

Women further mentioned that although cotton is entirely managed and owned by men, women are involved in some activities related to this crop: "*women and men grow the same crops except for cotton and even for that, we help them to cultivate. However, it is after the harvest that the women are not involved. In addition, they give nothing, even a 25fr. Even when you ask them, they don't give*.' This underlines the inequality when it comes to sharing the benefits from agricultural production.

The KII of men in Niono, the region of Ségou also revealed that "*Men and women all have their own plots. In addition, men and women help each other in farm activities. Women who own their plots do not exceed ten people. They also rent the plots to grow onions. On the other hand, this does not prevent them from helping the men in the fields*." This clearly shows the level of women involvement and their difficult access to developed rice farmland. One of main challenge is the limited access of women to lands in irrigated systems often due to interruption of land development by the agricultural authorities, hence very few women in reality own land in the developed irrigated zone.

Gendered roles in main farming activities

Though women are not independent producers for all crops production in the surveyed areas, they contribute somehow to agricultural activities for all the crops produced. The results of the study revealed the main activities that contribute to agricultural production and carried out by women, men, and youth in the rural areas.

Table 5. Gendered roles in rice and other crops farming activities

Activity	Task	Men	Women	Youth	Explanation
Land preparation	cleaning the cultivable fields	+++	+	+++ (young men)	Physically demanding
Ploughing	use human-powered agricultural equipment such as ploughs and	++	+	+++ (young men) + (young women)	Physically demanding

	oxen or machinery				
Seed spreading	Broadcasting of seeds	+++	+++	+++	
Sowing/planting	Sowing seeds or transplanting seeds	+++	++/+++	++ (young women on weekends?) ++ (young men as wage earners)	Physically demanding and may require possession of equipment. However, there are regional differences Transplanting is done by women
Irrigation	Water control in rice fields or during off-season vegetable farming	+++	+++	+++	Men are involved in rice farming; women and youth are engaged in vegetable farming
Weeding	Removing weeds from agricultural fields	+	+++	+	
Applying fertiliser, herbicides/ pesticides		+		+++	Physical effort and potential harmful effects
Harvesting	Mowing, collecting and piling rice	+++	+++	+++	Complementary roles
Transporting crop		+++		++ (young men)	
Winnowing			+++	++ (young women)	

The prevalence of men in preparation of fields/plots has consequences:

Women's plots are prepared at last moment as stated by a female farmer Boidiè: *"Men finish preparing their fields first, women wait for men until they finish preparing their fields".* This can put them behind in seeding activities and may have negative impact on their yield in the event of an interruption of rainfall. On the other hand, this also suggest that even though this is a male-dominated activity, women who are having the difficulty to have access to men's service are able to navigate this barrier by doing it themselves. A similar gendered engagement is also noted for ploughing which requires a great deal of physical effort and hence predominantly carried out by young men due to the perception that women cannot do such physically demanding tasks.

However, young women are also involved when it comes to the use of manual equipment. "*Men plough the plots. Women may pull the cows from time to time when ploughing. Young men plough mostly".* a participant of Male's FGD in Niono, Segou region said. The more affluent use tractors, which require financial resources that are generally held by men.

Seed spreading is practised exclusively in rice cultivation. It is done by both men and women as well as young people. "*Men spread the rice seeds as well as the women. During this activity, boys and girls help their parents".* A woman said during the FGD of Boidié, a region of Ségou. However, **sowing/planting is** carried out mainly by men who sow seeds in soil using hoe. This requires some physical effort on the one hand, and the possession of equipment such as seed drills and harrows on the other hand. *"There are women who sow or replant rice, but there are not many of them. It's rare and many of them don't do it",* a woman in female FGD in Ségou, N'gara stated. However, in the region of Sikasso, it is mainly women who do the preparation of nurseries and all the transplanting activities and do the sowing activities in their own field. Women and young people do transplanting mostly in a group as an income-generating activity. It consists of raising seedlings in a nursery and pull them for planting on a field that has already been prepared in the lowland. It requires less seed but much more labour compared to seed spreading. a respondent from Niono, Male's FGD confirms that *"women transplant mainly to meet their basic needs".* Women organize themselves in group to conduct this work on daily basis. Young women transplant on weekends and in school holidays to earn some money for their needs. *"At the time of this activity, everyone is doing it. Some people pay for the group of women who work in their fields on a daily basis",* a participant in Ke Macina female FGD declared. Male farmers hire the group of women transplanters while they are busy in other agricultural activities. Young men who are involved in transplanting are mainly season worker. They do it as daily wage earners.

Irrigation is generally part of the off-season vegetable farming activity or in the rice produced in lowland irrigation systems. For rice, men control the level of water in the field by closing the water passage to avoid any risk of flooding.

Women also control irrigation. They are also engaged in weeding, at all stages of cultivation. *"Yes, the women remove the grasses from the plots. This is their main activity"*, a man said during Dioro's male FGD. Adult and young men limitedly participate in this activity.

Applying fertiliser and herbicides/pesticides is an activity reserved for young men under the supervision of adult men. Protective measures against the harmful effects of chemical products and the physical effort required mean that it is entrusted to men. "*Men apply the fertilizer. Women hardly use fertilizer unless there is a need for it, men apply insecticides, women don't do this activity."* states a man during men FGD in Niono. Women often pay men to apply herbicides or insecticides to their fields.

Harvesting is conducted by men and women who work together on a harvesting line. During the harvest, women are generally responsible for collecting the grains and forming piles to make it easier to transport them from the field to the house or to the threshing floor. "*Harvest activity is done by men and women of all ages. As for the women and girls, they help men during harvesting. Women usually intervene when it comes to rice. It is always men who do the mowing and women take care of the collection, transport/storage of the paddy*", said a participant of female FGD in Ke macina. A man further supports this statement by saying that "*Men and young people mow the rice, and women collect it all the time to pile it up to the threshing air*", FGD Men's Blendio. This suggest that women play a central in harvesting activity.

Transporting grains from the field to the house is an activity reserved for men. It is the men who mostly own the carts and donkeys or motorcycle tricycles. Loading and unloading requires physical effort, therefore young men are mostly involved.

Winnowing is one of the last agricultural activities to be carried out exclusively by women. It a process to separate grains from impurities by wind or blowing air. Women do it for themselves, their families and to make money. This is also a source income generating activity for women. They are doing this as daily wage labourer.

In addition to farming activities, the communities surveyed gain their living from other small-scale activities derived from the agricultural sector, including vegetable crops farming in off-season, raising cattle, small ruminants and poultry, manual labour, and petty trading. The gendered participation in these activities can be discussed in detail on request.

Gendered perceptions of climate change and preferences and needs for CSA and CIS technology

Perceptions of climate change and its impact

This section presents an analysis of men and women farmers' perceptions of climate change. While some farmers link the causes of climate change to human activity, others felt that it was a natural phenomenon that they were unable to explain. There were no notable gendered differences in perceptions, but on impacts. The study shows that farmers perceive climate change as:

Rainfall variability: The lack of consistency determines rainfall. Woman farmers say in Kle FGD, "*we see heavy rain at the beginning of the rainy season and little rain towards the end. The rain starts late, and it is irregular. Rainfall is low ".* This point was also made by a male farmer attending N'gakoro FGD 'Over the last 15 years, we have noticed crop failure. We are seeing heavy rain at the beginning of the rainy season and limited rain towards the end.' This phenomenon of variability is badly affecting farmers and can lead to a decrease in the production. In addition, the alternation of heavy rain, sometimes causing flooding, and sparse rain, resulting in drought, is a factor in this perception. "We have noticed a change at the beginning and end of the rainy season. The variability of rainfall was such that the rainy season began in May. We were planting cotton that month. This year, the rainy season started in June, often in July. Often in September, which is normally the harvest month, but it still rains''" a farmer of women FGD in Baguineda. This alternation reduces the level of commitment to rice growing since it depends. On the availability of water in quantity, finally, rainfall has an impact on the start and end of the agricultural season. Furthermore, producers use to refer to signs that help them determine the beginning and end of the season. These signs are no longer accurate. *This is a regular occurrence. 'There are no more differences between the rainy signs*

in the year'. It used to rain early, but it's raining late now. **A participant from Siramana male FGD said.**

Water insufficiency and drought. Rainfall variability resulted to the drought in rural areas of Mali.

"Of the 49 families, more than 30 are affected by hunger. We need to invest in rice growing to alleviate the problem. We have lowlands but the shortage of water is preventing us from growing rice. We need to develop rice growing.", a man of N'gakoro said.

This scarcity of water may have the negative impact on the yield and slow down the development of rice production in Mali and lead to food insecurity. Another male participant from Kle added ''We are seeing things happening now that we didn't see in the past, such as prolonged drought, which didn't happen before but is happening now. These are all signs of climate change.' This highlight that drought is recurrent in rural Mali and affecting farmers in their agricultural activities. *This change is not caused by God, but rather by humans. We are experiencing climate change. We used to sow maize seeds here from May 1st, but now it's no longer possible. Now you have to sow short-cycle seeds.* A male farmer from Kle FGD said.

Flooding while some areas are affected by drought, other are dealing with the impact of flooding on their crops production. Flash flooding is also noticed in the rural area of Mali. *"There are places where we could grow maize and it worked well, but now these places are often flooded and that's where we grow."* Male FGD in Kle, Diola

Temperature variation: this is characterised by strong heat, sudden cold and drought. *"Heat and insufficient rainfall are signs that we have noticed over the last fifteen years. The heat was not as intense. Even now, there is heat. Cold and high heat alternate all the time. The duration of the cold season was three to four months. The duration of the cold no longer exceeds one month,"* a participant of female FGD in Finkolo Ganadougou, Sikasso said. This temperature variation may cause diseases to the population *''We have noticed the signs of climate change through the extreme heat, the heavy*

wind, and the rain stopped in September last year, which was not the case in the past. The absence of trees causes strong winds, extreme heat and brings disease to the community.' A woman from Loutana FGD mentioned. The intensity of heat is overwhelming and last more than cold duration A female farmer from Finkolo declared that ''The heat wasn't as intense. Even now it's hot. Cold and hot alternate all the time. The cold season used to last three to four months. The cold doesn't last more than a month now / The length of the cold season and the intensity of the heat'. These statements are showing that famers are facing the temperature variability in rural areas of Mali, and it is affecting their health. ''*The weather is hot during the day and cold at night. That's an instability.*' Said a woman farmer from **baguineda's female FGD.**

The frequency of violent winds: These changes occur throughout the year, but are more pronounced at the beginning, during and at the end of the winter season. A male participant from Kle FGD declared ''It's all due to climate change. There's more wind now than before. Even when it rains there's lightning and thunder, it's all due to climate change. The day before yesterday it caused some damage here. When we were children, it didn't cause so much damage. Besides temperature variation the frequency of violent winds may bring diseases. According to a participant from male FGD of Siramana ''some diseases caused by strong winds.'' This is also supported by a woman farmer from a female FGD in Baguineda ''*As the rainy season approaches, there are many cases of wind-related illnesses such as headaches, stomach aches and pneumonia. It used to happen but not on a large scale. Currently, the wind is stronger and accompanied by dust. Ambulatory illnesses are frequent.*'

Climate change is not neutral in its occurrence and impact. To the farmers they associate it with the human activity manifested in the felling of trees, the construction of factories and urbanisation and the use of fertilisers. The impact of climate change includes:

The degradation of farmland and lower crop yields: some farmers say that climate change has had a negative impact on their harvests: "*Over the last 15 years, we have seen a poor harvest*". a participant of N'gakoro said. They also say that there were places where they could grow maize and it worked

well, but that now these places are often flooded, and the maize can no longer yield. Others believe that short-cycle seeds should be sown. Another farmer declared ‘’*The farmland itself showed us that there has been climate change. We noticed a few things that really shocked us. There are certain species of worms in agricultural crops that we didn't know about in the past. These are rice diseases. The soil has become weak. For this reason, we're also changing over time, because we're using fertilizer to fertilizer and early maturing seeds to get a bit of yield.’* a man participating in male FGD in Kle

The outbreak of pests and diseases is characterised by the presence of destructive worms and certain seasonal diseases. As one respondent put it, *"we've noticed something that's really surprised us. There are certain qualities of worms in agricultural produce that we didn't know about in the past. These are rice diseases."* A participant of male FGD in San region said.

Climate change affects women more in their agricultural activities because they do not often have an alternate livelihood source. However, "w*omen invest more than they earn, they gradually abandon agriculture*" FGD Baguineda woman. The low yield and high cost of agriculture is pushing people to immigrate. *"Young people migrate to look for money and support their families during the lean season."* a producer from Siramana says.

Deforestation : even though men and women have different and similar observations regarding certain impacts of climate change, the results of this study clearly show that women are affected by the impacts of climate change in relation to deforestation, given that the collection of firewood is related to their reproductive activities. ‘’There's a shortage of firewood in the village. The trees that have been cut down are not being replaced by others. There are fewer and fewer trees in the forest.’ Mentioned a participant of female FGD in Loutana. This issue is again raised during another female FGD in Bendio ‘’Climate change is caused by us humans, because we are destroying trees and building factories that release bad air. People are no longer doing the right thing. You see, it rains in some places, and it doesn't in others. We can see that every hundred years there is a

change in the climate: building factories, destroying trees, drought, etc. Climate change is man-made.''

Table 6. Gendered perceptions of climate change in rural areas of Mali

Perceptions of Climate Change	Men	Women
Rainfall variability	x	X
Water insufficiency and drought,	x	X
Flooding	x	X
Temperature variation	x	X
Frequency of violent winds	x	X
Outbreak of pests and diseases	x	
Degradation of farmland and lower crop yields	x	
Deforestation		X

The chart above highlights both shared and gender-specific perceptions of climate change:

Shared perceptions (Men and Women): Both men and women express concerns about environmental changes such as rainfall variability, water scarcity, drought, flooding, temperature fluctuations, and extreme winds. These issues are recognized as disrupting communities, with climate-induced unpredictability threatening food security and livelihoods. Increased droughts, floods, and extreme weather are seen as major risks, heightening vulnerability and uncertainty.

Men's concerns: Men, often more involved in agriculture, are particularly worried about farmland degradation and reduced crop yields. Climate change impacts on soil health and productivity affect rural men, threatening food security and livelihoods.

Women's concerns: Women are especially concerned about deforestation, as it directly affects their access to firewood, water, and other resources for household needs. Deforestation, driven by agricultural expansion, increases their workload and limits access to essential resources, further hindering survival and economic activities.

Gendered preferences and needs for CSA and CIS technology

The results of the qualitative study clearly revealed that climate change is a reality in Mali.

Table 7. Summary of preferences and needs of women and men to adapt and mitigate climatic stresses

N°	Gendered preferences and needs for CSA and CIS Technologies	Men	Women	Both
	Climate information service			
1	Establishment of climate information clubs	x		
2	Provision of weather equipment	x		
	Soil improvement practices and innovations			
3	Annual reforestation			x
4	Access to small-scale irrigation system			X
5	Smart Valley	x		
6	Ploughing the field as soon as the first rains fall	x		
7	The use of pebbles to amend the soil	x		
8	Mulching and composting			x
	Agricultural equipment and other inputs			
9	Use of agricultural machineries			x
10	Use of herbicides, fertilizers, pesticides	x		
	Climate-resilient varieties and seeds			
11	Use of early maturing varieties			x
12	Drought-tolerant varieties	x		
13	Submergence-tolerant varieties	x		
14	Seeds production		x	
	Post-harvest management			
15	Hangar construction as shelter from the scorching sun	x		
16	The establishment of processing units and the adoption of improved parboiling technologies		x	

In terms of preferred technologies and needs for CSA and CIS practices, the study identified 16 key innovations grouped around climate information service and climate smart agriculture, soil improvement practices and innovations, agricultural equipment and other inputs, climate-resilient varieties and seeds, post-harvest management and other complementary needs relevant to rice production and agricultural production in general. Men and women were unanimous on the relevance of five technologies/practices namely tree planting, mulching and composting, small-scale irrigation, the use of mechanical tools and the adoption of early maturing seed varieties. The arguments made by men and women are converging. The women find it necessary to plant the trees that help lessen the effects of strong winds. "The winds are less strong in areas where there are trees," a FGD participant from Loutana said. This was also supported by the men of another locality. Planting trees is one of the best strategies to mitigate climate change for most the project communities *"We do reforestation every year and it helps to fight the drought."* A participant of Male FGD in N'gakoro. Both male and women FGDs expressed the need of regular reforestation to mitigate the effect of climatic stress related to drought.

The arguments are indicative of the different economic activities; access to an irrigation system illustrates. Access to water for livestock and market gardening, a wish, and a hope for the majority of male's FGD participants. *"The benefits of drilling are incalculable. First, we eat better sauce than before. Our animals drink without difficulty and we consume drinking water. We do market gardening through drilling. The borehole has facilitated market gardening such as the production of lettuce, tomato, papaya and other vegetables"* a participant of Male FGD in N'gakoro said. Provision of drilling system to both male and female farmers seem to facilitate the vegetables production during off season. This will increase their revenue and assure food security.

Each gender group also indicated its specific preferences.

For men, it was about the establishment of climate information clubs for better decision-making in agricultural activities, *"well if it is also possible to set up clubs that bring people together and talk to them about climate information. It should not be limited to TV and radio only. This information can also be passed on at farmers' training Sessions. We need to increase the means of information and awareness",* a participant of male's FGD in Ke macina. Men also were interested in improving soil fertility technologies and practices including adoption of Smart Valley[6], small-scale field irrigation and ploughing the field as soon as the first rains fall. Also, the suggest the use of pebbles to amend the soil, they are placed around plots to prevent fields from being flooded. The application of inputs including fertilizer, herbicide and insecticide. In terms of varietal adoption, men recommend the use of flood and drought tolerant seeds. For the men of N'gakoro, the adoption of improved seeds is one of the best adaptation strategies: "*We sow early, so we sow seeds with a fast cycle. We only know these two strategies. According to a participant of FGD from Siramana".* to protect against the adverse effects of climate change, men cited

6 Smart-Valleys is a participatory approach for land and water management in inland valleys. This approach enables farmers to improve water control at low cost by using simple means to design and construct drainage axes for siting irrigation canals and to create bunded and levelled fields according to the topological conditions.

the construction of sheds as a better strategy to shelter from the scorching sun; the hangar construction can validly combat heat and hot wind.

FGDs revealed to us that women are lagging behind when it comes to access agricultural machinery in the household. Their dependence on men puts them behind and significantly reduces their productivity. « We need farm equipment's like the seeder, weeder. » Female FGD, Missirila, Beleko. It was revealed that women are even limited on the question of renting. A woman from FGD Ifola said "*even if we women have money to rent the ploughing machine, this is not possible because we are not heads of household and the service providers do not find the size of our plots interesting. This has a huge impact on the yield if the rain is interrupted*". Yet another female participant further added that "*we need the agricultural equipment to be independent of men"* Female FGD in Ke macina, Segou.

Women dependency on men is not limited to agricultural machineries but also access to improved seeds which can mitigate the consequences of their delay in terms of interrupted rainfall. This statement is highlighted by a participant of female's FGD, Blendio, Sikasso "*Seeds that come through men's hands don't reach us easily. It's ideal to have a men's representative and a women's representative for easy access*". Another FGD expressed the need for training in seed production *« Yes, if we have the opportunity for training. We will do seed production. We have an agricultural cooperative here.* A participant of Female FGD Maninkoura. Seeds production seems to be the best strategies to facilitate access.

The establishment of processing units and the adoption of improved parboiling technologies stands as support to women to better position themselves in the rice value chain and eventually become the main actor in rice production. *"If we have rice processing equipment and we are trained in it, we will be able to take advantage of it. We're interested in parboiling. We rely on projects/NGOs to help us otherwise with the state, there is no hope."*

Gendered-based barriers and incentive mechanisms for adopting CSA and CIS technologies

Gendered-based barriers for adopting CSA and CIS technologies

According to the results of the study, most of the barriers are not specific to men with regard to the adoption of CSA technologies accessing to information, knowledge and skills and access to productive resources. Women additionally must contend with the management of domestic and field work, difficult access to farmland, dependency on men for access to agricultural equipment, to access agricultural information and the fear of abandoning their old practices in favour of the new agricultural technology.

The barriers constraining the adoption of Climate Information Services and Climate Smart Agriculture are summarized:

Table 8. Summary of barriers to the adoption of CSA practices by women and men

Barriers to the adoption of CSA and CIS practices	Men	Women	Both
Barriers to accessing information, knowledge and skills			
Illiteracy and language barriers			X
Difficulties in accessing information			X
Lack of awareness of new agricultural practices and technologies			X
Lack of training			X
Reduced support from State			X
Barriers to accessing the productive resources			
Insufficient of arable land for the integrated systems			X
Dependence on men to access agricultural equipment		X	
Unavailability of improved quality seeds			X
Regular renewal of improved seeds			X
Fluctuation of inputs Price			X
Lack of financial means and difficulty in accessing credit			X
Non membership of agricultural insurance			X
Heavy engagement in reproductive activities and risk averseness			
Time management		X	
Fear of adopting new technologies		X	

The findings show that men and women are faced with barriers related to information gaps. These include illiteracy, lack of information, low levels of support, and lack of knowledge of new agricultural technologies.

Illiteracy and language barriers: Illiteracy is mentioned as a major constraint to adopt technology like SMS for CIS. Language barriers illustrate the limited adoption of some climate smart technologies such as RiceAdvice: "*We don't know about this app. Is the information given in French? If so, we*

are not educated, we cannot use it." A participant of female FGD in N6 said. "*People are not interested. There are only five percent of people who have knowledge about RiceAdvice technology. We need to be trained in Bambara. We all understand Bambara.*" Woman FGD, Dioro, Ségou also confirmed. The language barriers lead to lack of interest in technology, especially by women producers.

Difficulties in accessing information: while television and radio continue to be the main means of disseminating climate information for rural people including to women, the complementarity with the current advent of smartphones, is not fully exploited: "*People are no longer interested because of phone use. People don't have time to listen to the radio*", a participant of Male FGD in Beleko Missirila, Dioila said. Prioritizing smartphones to disseminate information through apps like whatsApp could fill up the gap. It should also be noted that women often listen to radio or watch TV programs that broadcast debate on social issues or music for entertainment purpose. It will be ideal to broadcast climate information across these programs as an advertisement and if possible, in local languages. This could be a way to reach out women and ensure a full understanding by all segment of the community. This will likely reduce women dependence on men as well, thus increasing expansion of climate information.

Lack of awareness of the practices: the lack of awareness of climate-sensitive practices constitutes a major issue for women as well as male farmers in the study areas of Mali. This was revealed during the FGD of men in M'bewani, Heremakono "*you can adopt something only when you trust it. People need to be informed because out of 1000 people, if you have only 10 people who are trained or informed, it's not sufficient, so we need to inform more people*," said a participant. This statement suggests that lack of information is one of the important factors in the non-adoption of CSA technologies. Women are much more concerned than their male counterparts in accessing information on the practices; they are mostly dependent on men to have them. "*For men, it's not difficult. We access information on climate as well as climate adapted seeds through men*," a woman participant from FGD in Blendio, Sikasso confirmed.

Farmers expressed mostly their lack of awareness for CSA technologies like motorized weeders, integrated rice-vegetable systems, and GEM parboiler. A participant of male FGD in M'bewani declared that "*No it didn't arrive here yet. Everything you said right now, we don't know*." On the equipment that reduces physical strength such as weeders "*No, we don't know it. we are using the hoe to remove weeds,*" a woman said during the FGD woman in Klé, Dioila. This statement was supported by Male FGD in Missirila, Dioila *"No, we have not seen that too and we have no experience with this machine"* a male participant said. This demonstrates the lack of knowledge of CSA technologies by producers. Another participant from the same FGD added, "*What I can add is that all of us, that is to say we farmers, are all belonging to the Office du Niger. We do farming activities in our fields but many of us don't know good agricultural practices*." Women are particularly not aware of climate adapted varieties (varieties resistant to striga, flooding, and perennial rice) and innovations like integrated rice, fish, trees and vegetable systems.

The non-sharing of knowledge and information slows down the adoption of new practices. *"It's a matter of location. If it's practiced there, it's not easy for it to come here. Because we farmers don't like each other. The farmer will think, if he informs you that you are going to surpass him in terms of production"*; a man said during the male FGD in Ke Macina. The lack of awareness of the practices by the majority of producers limits substantial adoption.

Lack of training: Lack of training on the use of CSA practice was revealed during the study as one of the key barriers to the adoption of CSA technologies for both male and female farmers. "The *mechanical seeder was brought to us, but we didn't use it because we don't know how to use it. The machine is kept in the store now,* a male farmer of Beleko, Dioila said. Participant mentioned discrimination while designating people eligible for training. Selecting the right person can contribute to disseminating the information on new practices. "*You know our problem is also to choose people by affinity for training when they can't do the work afterwards*", a man said in M'bewani FGD. This failure to share information among producers might slow down awareness on the new technologies. In addition to that, the restriction of their mobility, low level of

education and discrimination result to their nonparticipation to the training, "*Women do not participate in training. We get information through the N'Ga Sene project. This project exploits us a lot because their products are expensive, and we reimburse a lot of money*", a woman said in Dialacoro, Selingué.

Social organization gives priority to men over women on every key thing including decision on who should attend training on behalf of the community. That social organization system constitutes part of the barriers to the women's full participation in training sessions. "*Women and their possessions are the property of men",* a woman in Beleko said. Their mobility requires permission of men.

The barriers to accessing adequate productive resources include the lack of and difficult access to developed land, the need to renew seeds regularly, the absence of mechanisms to control the constant price of agricultural inputs, lack of agricultural insurance

Insufficient of arable land to adopt the integrated rice systems: for instance, both male and female farmers find the technology integrated rice-fish system interesting and believe that it is a way to increase their revenue. However, the unavailability of dedicated lands and protection system creates some concerns over fish thefts. Female farmers face more challenge because they don't have land property. "*We know the integrated rice-fish system and had it here, but if we are not vigilant, we can have the fish stolen from the rice plot*." a woman from N6 said. They further add that "*Women can't adopt rice fish technology here; it requires owning a plot. Unfortunately, we don't own individual fields but collective*." This suggests that land ownership is a key factor preventing women from rice farming. A female participant in Ke macina women's FGD added; "*I need farmland, I don't have money to rent*" hereby showing that the land problem is not isolated but is rather also linked to finance.

Access to quality seeds and other inputs: Another major constraint women are facing in rice production is difficult access to climate adapted seeds. "*No, we don't know about quality seeds. Without the help of an educated*

person, we can be sold poor quality seeds." Maninkoura female FGD. Firstly, their awareness of the quality of seeds is very low, secondly, they are always dependent on men to access them *"seeds that come through the channel of men do not reach us easily. It is ideal to have a representative of men and a representative of women for easy access."* A woman from female FGD in Blendio, Sikasso said.

The problem of access to chemical fertilizers was also noted. The unavailability and increase in the price of fertilizer has been seen throughout the communities:

«*Our major problem is related to the supply of fertilizers. It is expensive and difficult to access*", a female farmer in Baguineda indicated. In recent years, farmers have been suffering from high prices of chemical fertilizer and difficult access. Such barriers for instance limit the adoption of RiceAdvice because it is difficult to respect all the recommendations made by the technology: [the RiceAdvice] "*it explains how to use fertilizers in the fields. In addition, we have not been in contact with these agents this year because we do not have fertilizer, and the price of fertilizer was too expensive for us. We don't have money to buy"* woman in Dioro's female FGD. This clearly illustrates how the price of inputs in combination with the financial issues are some of main factors of non-adoption of technology by female farmers.

This situation affects more women than their male counterparts "*Women do not get subsidized fertilizer. There was a time when there was a fertilizer problem. Agricultural agents had decided to proceed with the call of the cooperatives that have their receipts to supply them with fertilizer and those who don't have receipts or private individuals haven't had fertilizer. Otherwise, in recent years, there has been a lack"* said Lobougoula female FGD. In fact, subsidized fertilizers are given to recognized groupings. Members of these grouping are mostly men. As for women, they face challenges sometimes to find and adhere to recognized grouping. Unlike men, women have organizational problems to access subsidized fertilizers. Their plots are not always listed, and they are not always grouped together. Those who are in groups, few among them are registered, this situation puts women at a disadvantage in accessing subsidized fertilizers.

Lack of financial means and difficulty in accessing credit: Financial constraints limit adoptions of new technologies. Moreover, due to the variable climate and the rainfall patterns, it is advantageous to start the field activities early (such as land preparation) to be ready for the season's onset:
"…. *Some people start before others. Those who have money start field work early, so if you don't have money, it's very difficul*t..." said a woman during Loutana female FGD. However, female farmers are more affected by the finance shortage than their male counterparts "*Poverty will harm your entire rainy season, since when it comes to working in the fields, you will not have funds to plough the field while others have already begun. And you'll be late if you don't find credit*" a participant of female FGD in Loutana, Sikasso said.

Because women do not own equipment, service providers do not prioritize them because of their social status and sometimes if women ask to do their work for credit. "*The owners of the ploughing machines or service providers go where people give them money directly before they get to the others. If you don't have money, you must wait for others who have money first*", another female participant added.

Inadequate agricultural insurance: Farmers from Siramana male's FGD have expressed their dissatisfaction with the adoption of agricultural insurance by saying, "*We have suffered damage to our cotton crops. We have no solution. We have informed the agricultural agents so that measures can be taken. There were 12 subscribers to agricultural insurance. Only one of them received compensation. Out of 5,000 people, only 12 were subscribed. There were 10 women out of the 12*." Unlike in the Sikasso region where women dominate rice production, the majority of producers registered with agricultural insurance in the San region are men. "*There is only 40 per cent in agricultural insurance out of 5 000 producers. People have withdrawn due to expenses, 12 000 francs per hectare are paid yearly. Very few women are in this system because many of them do not have plots.*" Female FGD, San. Other limiting factors are the risk averseness or the fear of adopting new technologies and the heavy burden of reproductive activities.

Fear of adopting technologies: there are several examples linking this fear to the misconception of certain technologies. An example is perennial rice. According to a general societal belief in several communities, self-generated crops 'consumption could lead to unfortunate in the family. As the perennial rice grows on its own after harvest, men do not encourage use of this variety. "*We have varieties of similar characteristic. The adoption rate is mostly low. This perennial variety of rice is contrary to our habits and customs*." A woman in FGD Niono said it. "*If we grow this perennial rice variety, there is a risk of conflicts with farmers and herders. As a measure, it is necessary to impose custody of animals after harvest. It is the government that can warn the breeders so that we can exploit it*," added a participant of female FGD.

Gendered-based incentive mechanisms for adopting CSA and CIS technologies

Given the numerous barriers that farmers face, the incentives mechanisms to the adoption of CSA and CIS technologies are categorized in two complementary groups, the first group being that of mechanisms prior to establishing the technologies in the initiation phase and the second being the mechanisms that sustain adoption. These mechanisms don't differ between men and women; however, their application could differ in response to the gendered barriers. Table 9 summarizes the mechanisms:

Table 9. Gendered-based incentive mechanisms for adopting CSA and CIS technologies

Enabling factors to CSA practices	Men	Women	Both
Initiation mechanisms: Information and knowledge			
Training and awareness-raising on CSA practices			X
Expanding the communication network	X		
Training on seeds production	X		
Training on SRI technology		X	
Training in the production and use of compost			X
Regular visit of Extension agents	X		
Organize exchange meetings with seed producers	X		
Trained farmers must share farming knowledge to other group members and on local radio			X
Training feedback from beneficiaries to other group members		X	
Ensuring inclusion during training sessions		X	
The sustaining mechanisms: access to the technology and support			
Facilitate access to agricultural credit to enable the adoption CSA		X	
Agricultural inputs subsidy	X		
Facilitating access to CSA through the project or the government	X		

Support from government or NGOs to get farm equipment's			X
Payment of agricultural equipment in instalments	X		
Provision of seeds of early-maturing varieties and support farmers in seeds production		X	
Facilitate access to fertilizer		X	
Facilitate access to processing equipment and training in its usage		X	
Facilitate access to water to enable vegetable production during off season period		X	
Help needed for the construction of harvest storage warehouses	X		
Facilitate access to market	X		

Several mechanisms are centered around training.

Initiation mechanisms

The initiation mechanism is how the technology is packaged and how it is delivered. Before the adoption of CSA and CIS, the principal factor is knowledge **about technology**. This includes information about the technology itself, awareness that adds to the understanding of the technology, training on its usage and trying the technology and, hence acquiring the required skills. The necessity and mechanisms to build knowledge were noted by farmers.

In the first place, the general barrier of illiteracy needs to be addressed. Farmers expressed the need to have training on basic literacy to be able to adopt technology. "*The multiplication of exchanges between producers could improve the interest in SMS. We need training and literacy*." The general training and awareness-raising were a mechanism requested by both male and female farmers; men specifically indicated that the communication network should be expanded to keep producers informed about the new practices.

On access to information, IER was the main indicated source, and the office du Niger and NGOs additionally. Information is shared through radio, television and extension agents. Farmers recommended the necessary criteria of information. namely availability, accessibility, hence multiple media channels can be used:

"*Accessible communication channels… it is necessary to multiply the channels of information with the messages on radio... The SMS networks should be enlarged so that all the people can receive the short messages*" a participant of Ke macina male's FGD said.

The different approaches towards information dissemination were noted. For men, while television and radio continue to be the main means of disseminating climate information with the advent of smartphones, even rural men show less interest in news from radio and TV. "*People are no longer interested because of phone use. People don't have time to listen to the radio*", a participant of Male FGD in Beleko Missirila, Dioila said. Hence prioritizing smartphones to disseminate information through apps like WhatsApp could fill up the gap. To the women however, it should be noted that women continue to often listen to radio or watch TV programs that broadcast debate on social issues or music for entertainment purpose. Hence, it will be opportune to broadcast climate information across these programs as an advertisement and if possible, in local languages. This could be a way to reach out women and ensure a full understanding by all segment of the community. This will likely reduce women dependence on men as well to receive information, thus increasing expansion of climate information.

Producers requested training on various climate-smart practices and technologies: seed production and SRI technology (male farmers) and on production and use of compost (female farmers). Training is provided through extension service but also from farmer to farmer through exchange and the feedback of those who were previously trained (men recommendation), whereas women would also like to hear from the other beneficiaries. The training is seen as a transfer of knowledge, farmers show trust in the foresight and experience of the agents

"*We prefer extension agents because they are the researchers. They came to us. We understand some things through these people. These are people who see from afar. We adopt what they come to tell us because if they come to inform us, it means that they have heard, or they have seen somewhere*." Man in Ifola.Furthermore, women required that the training should be inclusive. The participation of the community stakeholders ensures that the language barrier is broken:

"*When there is a training, we also call the secretary, the treasurer, the training officer, the organization secretary and a person of monitoring...After the*

training, we bring everyone together. The secretary writes in French and explains in Bambara to people." Woman in Kle

There is an expectation that training is not just theoretical, but trainers deliver the technology. As illustrated, "*We want to have this machine through extension agents."* said a woman during female FGD in Kle, Dioila.

Regarding technology itself, it should be **responsive to the climate change effects**. This is mostly noted to the promotion of new varieties and mechanization, for instance:

"*They [trainers] explain to us the seeds that mature quickly to cope with possible drought.... Yes, if you have other varieties faster than that, you can provide us with that*". A woman from Kle female FGD said.

Sustaining mechanisms

The adoption sustaining mechanisms are mostly related to continuous access to the **necessary productive resources, and the institutional arrangements.** The key productive resources are **finance, land, seeds and fertilizer**. Mechanization is also increasingly demanding.

The general role of finance is to cover the cost of production including acquisition of inputs (seeds, fertilizer, equipment, etc.) and services (labor, hire, etc.). Women highlighted easy access to credit as a measure to ensure their autonomy vis-à-vis men. However, since the value of money has now gone down especially for women who find themselves earning low revenues, different measures are needed such as public support in terms of facilitating access to credit and subsidies. Farmers indicated:

"*All inputs have become very expensive, fertilizers, herbicides and insecticides……We need subsidies.* Woman in Loutana from female FGD.

The request of support to obtain equipment was really emphasized by both men and women. For men, they propose to have equipment by credit payable in instalments,

"*Initially, we benefited from the subsidy during the time of President IBK. The cost [of production] is very high, but with the subsidy, it becomes affordable.*

If it is through non-governmental organizations, we have access to equipment by credit." **Man in Dialacoro.**

Women additionally request access to early maturing varieties, fertilizer and processing equipment. Access to fertilizer is important to optimize productivity. Because the cost of fertilizer has become expensive, hence farmers are adopting composting.

… "*We are all interested, men, women and young people in participating in composting training. This is better because the price of fertilizer is very high*". **Woman from female FGD of Baguineda said.**

Therefore, it will be helpful to provide knowledge about green manure in general and the different less costly options of various combinations of green and chemical fertilization techniques to farmers to minimize their costs and maintain good/increase their production.

Additionally, women request access to water because one of the CSA applications is growing vegetables in rice-vegetable systems which is also for on-farm diversification.

Other enabling factors include access to storage, post-harvest technology and market:

"*We need support to have storage warehouses for the preservation of agricultural products after harvest ...to avoid crop losses*" **Man in Baguineda Village from male FGD.**

"*If we have rice processing equipment and we are trained on it [its usage], we will be able to take advantage of it. We're interested in parboiling. We rely on projects/NGOs to help us otherwise with the state, there is no hope*. Woman from female FGD in **Ké Macina**

Noting that the storage and processing equipment are often facilitated through associations, in terms of institutional arrangement, organizing in farmer associations show several advantages. It enables sharing knowledge acquired, inclusion and increasing bargaining power and access to better markets.

Lastly, with an understanding that climate change is an agricultural risk, an agricultural insurance mechanism should be adequately implemented.

…. *there are more women than men interested in agricultural insurance [because]... women have small plots of land that are not very fertile, and their fields are ploughed late; the men first plough their fields and then it is the women's turn*…. Man from Siramana male FGD.

It was established by women that since that risk is further compounded by gender inequalities, women stand to gain more from the insurance.

The technologies or practices adopted by men and women based on the data collected

The present study has allowed us to evaluate the extent of adoption of climate-smart technologies (CSA) and climate information services (CIS) at the project sites. Our findings indicate that men and women do not adopt CSA and CIS technologies at the same rate. Several factors may contribute to this disparity, including socio-cultural norms, financial constraints (such as the inability to purchase inputs), lack of training and literacy, as well as differences in access to and control over agricultural resources. Unlike men, women are generally less familiar with new farming techniques.

The status of adoption of AIC and CIS by male and female farmers are summarized in the table below

Table 10. Summary of the adoption level of CSA and CIS practices and technologies by women and men

Technologies/practices adopted by the communities	Level of adoption		Adoption observed	
	Men	Women	Men	women
Agricultural inputs				
Insecticides/Herbicides	Strong	Medium	Men apply insecticides and herbicides and are generally able to pay for farming inputs	Women hardly apply insecticides or herbicides; they pay men to apply them/ they also face financial constraints and often rely on men to access inputs.
Early Maturing Seeds	High	Medium	Many men farmers adopt early maturing seeds, a strategy that enables them to obtain better yields in the face of climate variability.	Women also use early-maturing seeds but face challenges in accessing them. Most of them are unaware of climate sensitive seeds and depending on their male counterparts.
Flood-Resistant Seeds	Medium	Low	Men are more likely to be familiar with flood-resistant seed varieties.	Women are less familiar with flood-resistant varieties, though some adopt them.
Chemical fertilizers	Strong	Medium	Men have better access to chemical and organic fertilizers.	Women often face challenges in accessing fertilizer, especially chemical ones.
Composting	Medium	Low	Men use compost as part of their farming practices.	Women also use compost, often to supplement chemical fertilizer. They face financial constraints to apply to apply the amount requires
Use of Cow Dung and Neem leaves (Organic Fertilizer)	Strong	Medium	Men use organic fertilizers like cow dung.	Women use organic fertilizers, including cow dung and tree branches.

Use of Mechanical Equipment

Ploughing machine/ Access to Tractors	Very strong	Medium	Men have access to and use mechanical equipment. They often rent or own tractors for ploughing and others agricultural equipment.	Women do not have access to these agricultural machines and often don't know how to use them. they typically do not have access to agricultural equipment and rely on men to use them.
Seed drilling machine	Low	No adoption	Men are trained to use these machines.	Women are not trained to use these machines. But they still have difficulties using it.
Threshing machines	Strong adoption	Strong adoption	Men own and use threshing machines, improving efficiency. They also have priority to rent	Women do not have priority to access to such equipment; they rely on men.
Weeding machine	Low	No adoption	No trained, don't use it	Unaware of it
husking machine	Strong	Strong		
Traditional and improved Parboiling equipment's	No adoption	strong	Men may use these machines, but not as commonly.	Women are more likely to use these machines for parboiling rice.
GEM parboiler	No	Low		
Solar Pump Irrigation system	Medium	low	Men own and use irrigation pumps.	Women use solar irrigation systems, though only a small percentage.
RiceAdvice	Low	low	Men are familiar with the RiceAdvice app	Women are not familiar with the RiceAdvice app.
Agricultural Insurance	Low	Low	Men have access to agricultural insurance.	Few women are subscribed to insurance due to financial limitations and lack of trust
Agricultural calendar	Strong	Medium	Men farmers are provided agricultural calendar	Women are depending on men to have it
Extension agents	Medium	low	Some male farmers often met extension agents	Women farmers hardly meet extension agents
CIS/ Radio broadcasting	Strong	Medium	Men mostly use radio to have information on weather	Women are depending on men to have information on weather. They hardly use radio to have climate information
SMS	Low	Very low	Some literate men receive climate information through SMS.	Women farmers are affected by illiteracy. They use SMS to receive on weather.

Financial constraints and women's adoption of agricultural techniques

Financial constraints are among the primary obstacles to the adoption of new agricultural techniques by women. Additionally, women face significant time

constraints. A female participant in the FGD in Maninkoura stated, *"Women are very busy. They don't have time to adopt all the practices."* These challenges have made women unfamiliar with many new techniques and have **slowed their adoption**. The study found **that limited physical and financial access to pesticides and insecticides** further restricts their use by women. Moreover, women often lack knowledge of how to apply these chemicals and rely on men for assistance. A participant in the Ifola FGD explained**,** *"We don't use herbicides because of a lack of money; some people use them, others don't."* Another participant in a mixed-gender FGD in Boidié said, "*Women don't know how to use insecticides or herbicides. So, we pay the men to use them on our plots. The women don't apply these inputs."* This statement highlights that women face a lack of knowledge, which contributes to their low adoption of these technologies.

Adoption of climate-adapted innovations

Adoption of climate-resilient seeds

The adoption of climate-adapted seeds is a crucial strategy for mitigating the effects of climate change on agricultural production. These seeds are widely adopted by farmers, particularly men, who favor early-maturing, flood-resistant, and drought-resistant varieties for better yields. While women also use these seeds, they are less familiar with them and face challenges in accessing them. They often rely on male farmers for climate-adapted seeds. A woman participant from Maninkoura shared, *"This is more profitable than Adeny. We have trouble accessing quality seeds. The yield decreases every year, and the demand for seeds is too high."* Despite the high adoption rates of improved seeds by men, some are still unaware of flood-resistant varieties. One man in a male FGD in Missirila, Beleko, stated, *"We have tried all kinds of rice varieties. However, we don't know about this variety resistant to floods."*

Fertilizer adoption

Regarding the use of fertilizers, both chemical and composting, men tend to have a higher level of adoption. Despite challenges in accessing subsidized fertilizers, men still make use of them. Women, on the other hand, also use compost, often to supplement chemical fertilizers due to financial constraints. A woman participant from the Baguineda FGD explained, *"Women get together*

to buy a bag of chemical fertilizer and share it. They supplement the small amount of fertilizer with organic manure."

Agricultural equipment adoption

The adoption of agricultural equipment, such as ploughs, tractors, and threshing machines, is high among both men and women. However, women face challenges in accessing these resources, particularly for ploughing equipment. A female participant from the Beleko female FGD noted, *"Women suffer more than men. Women don't have agricultural equipment, and they have to wait for the men to use it first."* This sentiment was echoed by another woman in the Kle female FGD: *"We don't have a machine for farming rice. We always plough and sow our plots late. Men get their rice sown first, and only then can women start sowing their rice. We don't have our own equipment here. We want our own machine."* The adoption of mechanical seed drilling machines is low for both men and women, likely due to a lack of training. A man participant from Beleko shared*, "We were given one of these machines, but we haven't used it because we don't know how to operate it. The machine is kept at home for now due to the lack of training in its use."*

Solar pump irrigation system

The solar pump irrigation system is adopted by both male and female farmers, but its adoption among women is low due to the financial investment required. A woman participant from Beleko explained, *"The men use irrigation pumps and other irrigation equipment to continue vegetable production during the off-season."*

Agricultural insurance

The adoption of agricultural insurance is very low, with some farmers even abandoning it due to a lack of trust and financial means. A female participant from the San Female FGD said*, "Only forty percent of farmers have agricultural insurance out of five thousand producers. Many people have dropped out because of the cost; they pay twelve thousand francs per hectare per year and per year. There are very few women in this system because many don't have land."* This was further confirmed during a male FGD in Siramana, Sikasso,

where a participant noted, *"We suffered damage to our cotton crop and had no solution. We informed the agricultural agents so that measures could be taken. Only twelve people subscribed to agricultural insurance. Only one of them received compensation. Out of 5,000 people, only twelve were subscribed, and ten of them were women."* This statement underscores the lack of transparency and the financial barriers to participation.

RiceAdvice Application

The adoption of the RiceAdvice application is low, as it is new to farmers in rural areas of Mali and requires some literacy skills. A male participant from Beleko remarked*, "We have no experience with this application. But the Africa Rice project has been here to try it out."*

Traditional and improved parboiling equipment

Traditional parboiling equipment, as well as improved technologies, are widely adopted by women. However, the adoption of the GEM parboiler is very low. Men do not adopt parboiling technologies, making this activity predominantly women led.

Agricultural calendar and extension services

Both male and female farmers adopt the agricultural calendar and follow advice from extension services. However, women face challenges in meeting with agricultural agents. A male participant from Ifola, Sikasso, shared, *"We follow the weather calendar and sow the seeds early to overcome the variability of the rains."* Another woman farmer from N'gakoro, Segou confirmed and shared, *"The agricultural calendar is sent to us, and we adopt it. When we follow the calendar, it improves our yields.'*

DISCUSSION

On gendered patterns and divisions of labor of agricultural activities

In this study, we examined the extent to which men and women engage in different agricultural activities in Mali and the associated normative expectations helping to explain these patterns. Our results align with gender

dynamics in agriculture that are well-established in literature. Men are typically considered as the 'farmer' and they control or manage crop production – both cash crops and lucrative food crops – and have access to better quality land and inputs compared to women. Women, on the other hand, are considered in a supporting role to provide labor for men's agricultural activities and occupy their own cropping activities on smaller and lower quality pieces of land and with fewer resources. Women's access to land is mediated by men. Participants explained that access to land is a key factor limiting women's ability to participate in agricultural production activities, particularly of lucrative crops such as rice.

Men and women are active in different production activities. Men and young men are reported to be more involved in certain activities that are considered more physically demanding or that which requires equipment. Yet women and young women are involved in all steps of production – including these perceived to be physically demanding – and their level of engagement may vary by type of crop. For example, as men are more heavily involved in irrigated rice fields, women and youth are heavily involved in irrigation for vegetables. However, certain tasks – such as applying fertilizer or pesticides, and transportation – are considered reserved only for men. And winnowing – the process to separate grains from impurities – is a task reserved only for women.

On gendered perceptions of climate change and preferences and needs for CSA and CIS technology

Similar to results presented in Sanogo et al. (2023), men and women in this sample were aware of climate change and described various perceptions of a changing climate, although these changes were attributed to both climate change due to human activity and as an unexplainable natural phenomenon. Participants discussed perceptions of variable rainfall, increased incidence of drought, flooding, and fluctuation in temperatures and wind extremes. Men and women identified different preferences for CSA and CIS technology to strengthen their resilience to climate change. Men preferred different forms of CIS, soil improvement practices and innovations, use of herbicides and other chemical inputs, drought- and flood-tolerant rice varieties, and using physical construction to block increasing sunlight exposure. Women and men both preferred annual reforestation practices, access to small-scale irrigation, mulching and composting, use of machines, and use of early maturing rice varieties. Women preferred increased seed production, establishing processing

units, and using improved parboiling technologies. These preferences map closely to men's and women's roles in rice production and processing activities, as men prefer practices that address issues focused on rice production whereas women express preferences for technologies and tools to strengthen rice processing activities.

On gendered-based barriers and incentive mechanisms for adopting CSA and CIS technologies

Similar to results presented from previous studies in the region (Sanogo et al. 2023; Alhassan et al. 2018; Ouedraogo et al. 2018) men and women farmers in Mali face key barriers that limit their ability or desire to adopt CSA and CIS technologies and practices. Both men and women face key barriers to strengthen knowledge, skills, and information include a lack of awareness of and access to existing information (including new agricultural practices and technologies), lack of training opportunities, limited state support to strengthen access, and language and literacy barriers. Both men and women experience challenges in doing a regular renewal of improved seeds due to price fluctuations, lack of financial means to invest in new varieties, difficult accessing credit, and lack of insurance. However, it was noted that women are more interested in insurance than men given the increased risk women face in their agricultural activities. Men and women both face difficulties in accessing quality arable land for integrated systems, but women's access to key resources, such as land, credit, labor, inputs, and time are often mediated by or existing social norms that place other time-intensive activities (such as childcare and domestic chores) within women's responsibility. Unlike men, women expressed a level of fear in adopting new technologies associated with the unknown risk involved.

However, given these barriers, men and women participants cited preferences for mechanisms to promote their ability to adopt CSA and CIS technologies. With respect to improving access to information and knowledge, both men and women expressed a desire for more training on different technologies and practices to promote better agricultural practices. With respect to improving access to technology and support, both men and women requested increased support from the government to facilitate men's and women's access to agricultural equipment. And men and women expressed other preferences or requests for support. Men requested more frequent visits from extension agents whereas women did not mention this. Men also wanted increases in

other forms of public support, including input subsidies and increased public access to CSA, and other support in enabling them to purchase or construct materials on credit, and facilitating access to markets.

Women, on the other hand, requested more inclusivity in trainings to ensure they are accessible to more individuals beyond just men farmers. They discussed options to ensure that information delivered at trainings are able to be shared with those beyond the training participants. And they requested improved ability to access key resources, such as credit, seeds, inputs, equipment, and water.

CONCLUSIONS

In summary, this study explored the gendered patterns in labor dynamics on agricultural activities across Mali and examined the differences in men's and women's perceptions of climate change and their abilities to adopt CSA and CIS technologies to strengthen their resilience to changing climatic conditions. Men and women discussed their perceptions and barriers typically aligned with their roles in rice and other agricultural production systems. While men and women both face key barriers in their ability to adopt these technologies, women face disproportionate barriers including a lack of equal access to land or credit that hinders their ability to adopt these technologies. Given these factors, coupled with the stated preferences of men and women to support them in adopting CIS and CSA, we suggest the following recommendations to strengthen programming in reaching men and women farmers in Mali and facilitating their uptake of CSA and CIS technologies:

- Ensure CIS and other information-based services are available in Bambara and other local languages as applicable. These services should be delivered using appropriate means given farmers' literacy and technology access.
- Work in collaboration with public extension services in Mali to increase the availability and accessibility of trainings on various topics for farmers.
    - Ensure these trainings are inclusive and employ a gender-sensitive approach to include women and others who may be excluded.

  - Consider using a training of the trainer approach to enable training participants to share their learned information with others within the community.
- Work with micro-finance and other financial institutions and lending groups to strengthen and improve options for women to access credit.
- Utilize training and other information campaigns to spread awareness of new resilient crop varieties and how to access them, as well as new practices to strengthen farm resilience to climate change.

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APPENDIX

Table A1.Gender-wise crops production in different regions of study

Gender -wise crops production (F=Female, Male=M)

Regions	Villages	Rice	Maize	ground nut	Millet/ Sorgho	Potato	Bean	Cotton	Sweet potato	Okra	Onion	Cabbage	Lettuce	Tomato	Fonio	Green pepper	Chili	Egg plant
Ségou	Niono N6	90% M	50%F				90%F		100%M	95%F	70%F	50%F		80%M			95%F	
	M'bewani	80% M		50%M		95% M	70%F		100%M	90%F	70%F	70%F		100%F			60% M	
	Kolongo	100% M	50% M	85%M	100%M	100% M	100%M		100%M	95% M	80%F	50%F	90%F	85%F		70%F	98%F	
	N'gakoro		100% M	75%F	100%M		50%F				100%F	100%F	100%F	100%F	100% M		100% F	
	Ke macina	96% M	100% M	80%F	98%M	80% M	90%M		60% F	50% M	95%F	60%F	95%F	90%F	50%F	50%F	50%F	70%F
	Dioro	92% M		100%F	100%M		100%M			100% F	85%F	100%F	100%F	100%F	100% M			
	N'gara	90% M	100% M	80%M	100%M		80%M				95%F				100% M			
	Baroueli	100% M	95% M	85%M	98%M		92%M	100%M		50%F	95%F	50%F	85%F	95%F	97%M			
San	San	70% M	100% M	60%M	100%M	80% M	95%M		90%M		95%M			60%M	100% M		60% M	
Sikasso	Siramana	75%F	95% M	90%F		100% M	100%F		98%M	70%F			100%F	60%M			50%F	95%M
	Loutana	80%F	70% M	70%F	100%M		80%F	100%M		100% F		70%F						
	Lobougoula	60%F	80% M	80%F	100%M	100% M	70%M	100%M	60%M		80%F			90%M			80% M	
	Blendio	60%F	100% F	60%M			100%M	100%F	100%M					90%F				
	Finkolo Ganadougou	85%F	75%	50%F	100%M		50%F	100%M	100%M	60%F	90%F		75%M			100% F	75% M	100%M
	Ifola	85%F	80% M	50%F	100%M	100% M	100%F	100%F	100%M					60%M			50%F	

Selingué	Dialacoro	90% M	95% M	90%F	100%M		90% M		100%M	100% M	100%M		100% M					100%M
Dioila	Kle	95%F	100% M	50%F	100%M	50%F	95%M	100%M			50%F			50%F				50%F
	Beleko	80M %	98% M	80%F	60%M	100% F	80%F	100%M		95%F	80%F			100%F				
Koulikoro	Baguineda	90% M	90% M			100% M	70%M		70%M	60% M	60%M		80%F	70%M	90%F	80%M		50%F
	Maninkoura	95% M	97% M	98%F	100%M		80%M											