CHAPTER 4

Gender Inequalities in STEM: Focusing on Agricultural Science in West African Public Universities and Research Units

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Introduction

Agroforestry systems improve agriculture's resilience, enhance local farmers' livelihoods and contribute to balancing global ecosystems. However, women in West Africa are discouraged from engaging in agroforestry and face challenges accessing technologies tailored to their needs (Kiptot & Franzel, 2012). A pervasive gender bias has historically kept the agricultural sector male-dominated in West African countries, underscoring the importance of achieving gender equality in agricultural research to foster sustainable development in the region. This study builds on previous research indicating gender biases affect women's participation and leadership in Science, Technology, Engineering and Mathematics (STEM) fields, focusing on applied agricultural research and sciences in West Africa (Fakoya et al., 2010; FAO, 2021; Kiptot & Franzel, 2012). Specifically, we aim to better understand gender biases in both agricultural work and research.

Despite the attention to gender accorded by various programmes implemented in West Africa and international actors (e.g. the Agricultural

Productivity Programme in West Africa, Women in Climate Resilience Agriculture in West and Central Africa, Economic Community of West Africa agricultural policy), women continue to be underrepresented in agricultural research and development communities in West Africa (Hagège & Condon, 2021). In agricultural science, women make up 36% of the global workforce (FAO, 2023) and face barriers limiting their productivity and earnings (FAO, 2021). Research and initiatives in agricultural science should prioritise addressing gender-based barriers, considering the experiences and concerns of both men and women (Ayinde et al., 2013). While some progress has been made in improving gender balance in universities and research teams in sub-Saharan countries (e.g. Benin) (Direnberger & Onibon Doubogan, 2022), further efforts are necessary to address gender bias in agricultural sciences and applied agriculture research.

Women's participation in agricultural science is critical to ensuring the representation of diverse perspectives. One contributor to gender inequality in agricultural research is the lack of an appropriate research methodology in survey design and data analysis, which leads to biased results that marginalise women farmers' opinions (Savran Al-Haik, 2016); more women in agricultural science, designing research and analysing data can help address this issue. Involving farmers, especially women farmers, in research and technology development is crucial to ensuring that the technologies being developed meet their needs, yet existing research methods may not accurately reflect farmers' realities due to gender biases. To truly include women farmers, researchers must understand the social norms, roles and constraints that shape their daily lives and work. A gender-sensitive approach, one that considers the diverse identities of both farmers and researchers, is essential to producing fair, accurate and relevant agricultural science.

To better understand the current landscape surrounding gender equality in agricultural science in West Africa, the current chapter addresses the following three questions.

1. What is the state of gender-based inequalities in agricultural science in West Africa?
2. Do student-enrolment trends in West African universities suggest progress towards gender equality in agricultural science?
3. What factors are associated with gender-based inequalities in (a) agricultural work and (b) agricultural research in West Africa?

In Question 3, we seek to focus on both agricultural work and agricultural research, because we argue that for researchers to effectively address gender inequalities in their research, they must also have a better understanding of the gender inequalities faced by workers themselves. Further, by better understanding the norms around agricultural work, researchers can be more sensitive to such norms in their data collection and analyses.

All three of these research questions were investigated by focusing on three Francophone West African countries: Benin, Côte d'Ivoire and Niger. These countries share a similar education system and organisation of universities as members of the African and Malagasy Council for Higher Education, therefore are comparable to a degree, yet different socio-cultural norms mean they offer a broader view of gender inclusion in agricultural research across the region. Our research aimed to go beyond simply presenting gender statistics and instead focuses on understanding factors related to gender disparities in agricultural work and research, and considering how to address these factors.

Methodological approach

The data collection was conducted in three ways: (1) a survey of staff in training institutions using a questionnaire for quantitative and qualitative data collection; (2) a meta-analysis of published research; and (3) the participatory rural appraisal (Chambers, 1994) method used to more deeply explain the factors associated with gender-based inequalities in agricultural research.

For interviews with staff in research institutions, the consent of the participants was obtained. This consent was established by completing the survey questionnaire, agreeing to disclose their identity and signing attendance lists during the interviews. The research activities were approved and authorised by the respective local ethics committees for the scientific research of each project partner (University of Parakou, Nangui Abrogoua University and University of Diffa).

Survey of training and research institutions

To better understand gender inequalities in agriculture and move towards gender equality, we collected both quantitative and qualitative data.

Quantitative data covered the numbers, by gender, of students enrolled and trained in agricultural training courses over the last three decades (1990–2020); teaching staff and research team members; managers in training and research structures; and the number of research projects submitted and funded by gender (Question 2).

Qualitative data focused on sociological constraints and sexist stereotypes affecting the consideration of women's concerns in agricultural research, methodological approaches in the agricultural sciences and possible solutions to strengthen the inclusion of women in agricultural research (Questions 1 and 3).

Data were collected via surveys of managers and other administrative human resources personnel in public universities (a total of 10 universities), research centres (a total of 6 research centres) and university research laboratories (a total of 40 laboratories) in Benin, Côte d'Ivoire and Niger.

The data collected were managed in the ACCESS relational database management system, then extracted for statistical analysis. Prior to highlighting agricultural research participation across the three countries, we conducted a statistical inference (Chi-square homogeneity test) to test whether there is a significant difference in the distribution of male and female staff within the agricultural science training structures of public universities in Benin, Niger and Côte d'Ivoire. We found no significant differences in gender distributions across the three countries (see statistics below); this lack of difference further motivated investigating the three contexts in one study. The enrolment and qualification data for universities in the three countries were described through descriptive statistics (relative frequency calculation). Graphs (e.g. histograms, curves) were also constructed to better describe the data. All data analysis and graphics were performed using R software (R Core Team, 2024). Notably, due to the country's socio-political and security contingencies, data could not be obtained on all metrics for institutions in Niger; therefore, some of the presented results include only data from Benin and Côte d'Ivoire.

Meta-analysis

To better understand the factors associated with gender-based inequality in agricultural research (Question 3), we searched for agricultural studies (i.e. studies in agricultural production systems, including land management, agri-environment, crop and livestock production, rural economics and sociology, farm management and financing, and food processing) published in West Africa between January 2012 and December 2021. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method facilitated

study selection and data extraction. A data matrix – "Inclusion or non-inclusion of gender crossed with sampling type" – was extracted from the raw database before data selection. Fisher's exact test was applied to assess the relationship between gender inclusion and sampling type (Poitevineau, 2004). The selected studies were statistically summarised through meta-analysis to estimate the proportion of women in the survey samples, with the goal of assessing the hypothesis of gender inequality in the study sampling. Univariate meta-analyses were conducted to explore the factors linked to this inequality. The analyses were performed in R software (R Core Team, 2022).

Case study using participatory rural appraisal

To answer Question 3 in more detail and to identify possible endogenous approaches to reducing gender inequalities in agricultural study samples and developing an inclusive, gender-sensitive methodology, a case study based on participatory research was carried out in Benin, one of the three focal countries. Using the participatory rural appraisal (Chambers, 1994) method, data collection took place in Benin. Participatory rural appraisal (PRA) refers to a set of flexible, low-cost and efficient methods used to enable workers to collect and analyse information about rural communities. It helps workers understand the past, present and future conditions of these areas. By doing so, PRA provides a complete view of challenges, opportunities, resources and solutions within rural settings. This approach aims to achieve specific goals within a set timeframe by involving the community in planning and decision-making processes (Chandra, 2010; see Chapter 11 for another example of the use of participatory research methods).

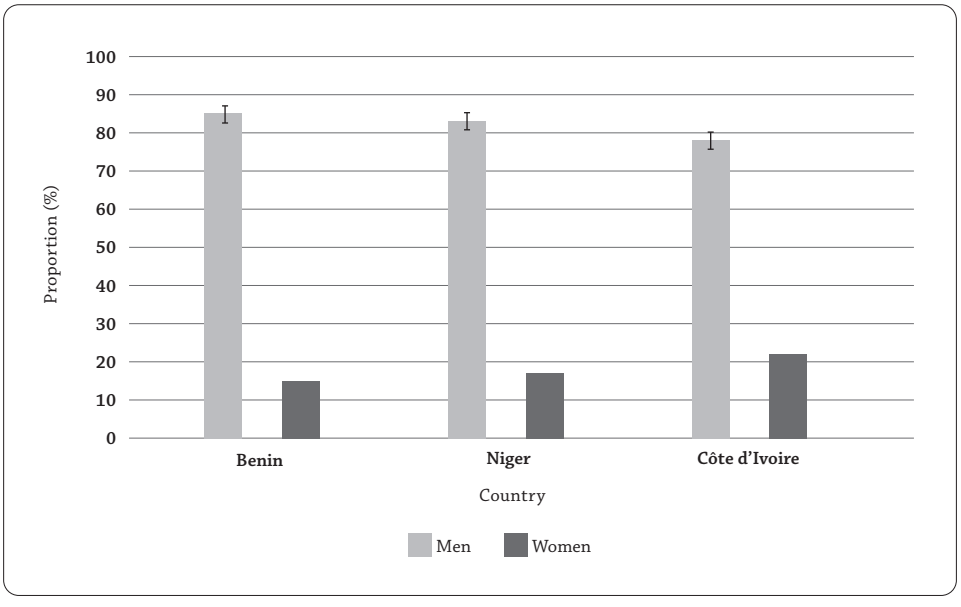
PRA enables researchers to gather insights directly from local people and encourages their active participation in searching for solutions to their problems and decision-making processes. This approach was used to engage both female and male farmers in understanding and analysing the gender-based bias in agricultural research. Farmers were interviewed in three groups: a women-only group, a men-only group and a mixed group including the participants in both previous groups. Interviews were conducted simultaneously in each locality. Through discussions with each group, valuable insights were gathered regarding gender roles in agricultural data collection and the reasons for gender disparities in respondent selection for agricultural surveys. Various data collection methods, including observation, interviews, diagrams, games and workshops, were utilised to gather information.

Results

Gender inequalities are prevalent in agricultural science in West Africa

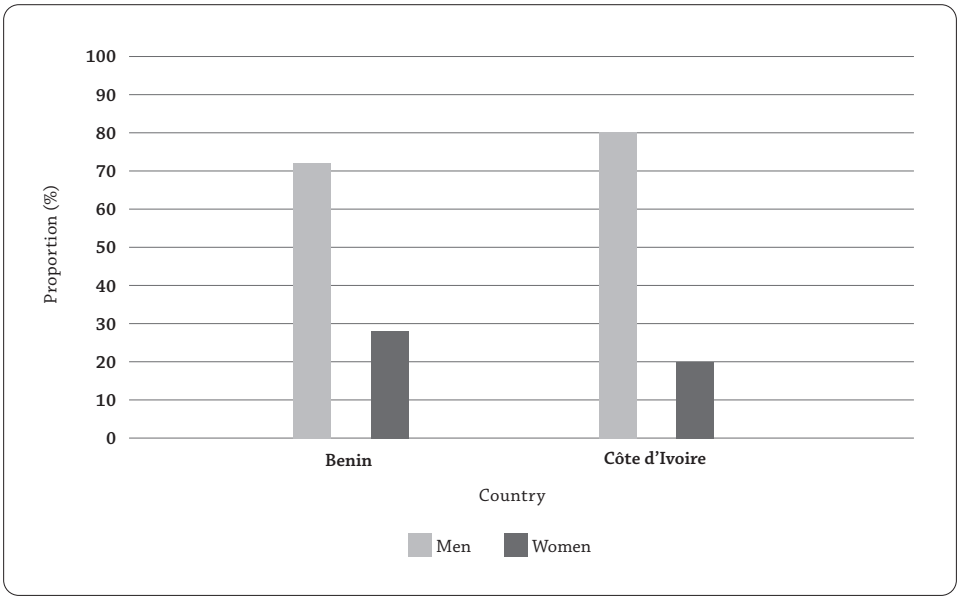
To address Question 1, we investigate the proportions of women and men across a variety of institutions in the three focal countries. We start by presenting the proportion of female teachers in agricultural science courses at public universities and private research institutions. Proportions of women were below 25% in all public universities (15.36% in Benin, 17.19% in Niger and 22.22% in Côte d'Ivoire, see Figure 1). The proportions of women in STEM focusing on agricultural science training in public universities are not statistically different across the three countries (χ^2 : 5.4344, df: 2; p-value = 0.06606); this suggests, as anticipated, that there are similarities in gender disparities across the three countries.

Figure 1: Gendered distribution of teachers in agricultural science training structures in public universities in Benin, Niger and Côte d'Ivoire



Like the public universities, agricultural science research centres (public research institutions that are not universities) also showed low rates of women representation, at 27.76% in Benin and 20.50% in Côte d'Ivoire (Figure 2).

Figure 2: Gendered distribution of researchers in agricultural science research centres in Benin and Côte d'Ivoire



Gender statistics of the research team staff

In the field of agricultural science, in 2023, women represented 16.46% of members of research teams in public universities in Benin and 21.15% in the public universities of Côte d'Ivoire, that is a representation average of 19% for the two countries (Table 1).

Table 1: Statistics on research team personnel

Country	Men		Women	
	Number	Rate (%)	Number	Rate (%)
Benin	82	78.85	22	21.15
Côte d'Ivoire	137	83.54	27	16.46

Periodic gender-disaggregated data for lead investigators on research proposals submitted and funded research projects

In the field of STEM focusing on agricultural science, research proposals were submitted for funding by a minority of women and did not exceed 31% in the public universities of Benin, Niger and Côte d'Ivoire (Table 2). The proportion

of women teacher–researchers who submitted research proposals to research teams was between 15% and 30% for the three countries represented (Table 2).

Table 2: Periodic statistics on research proposals submitted by gender in STEM focusing on agricultural science research teams in public universities in Benin, Niger and Côte d'Ivoire

Country (period)	Men		Women	
	Number	Rate (%)	Number	Rate (%)
Benin (2018–2021)	27	72.97	10	27.03
Côte d'Ivoire (2007–2021)	34	69.39	15	30.61
Niger (2016–2021)	11	84.62	2	15.38

In the field of agricultural science, the rate of women teacher-researchers with funded research projects was 9.09% (2018–2021 period), 20% (2016–2021 period) and 33.33% (2007–2021 period) respectively in the public universities of Benin, Niger and Côte d'Ivoire (Table 3).

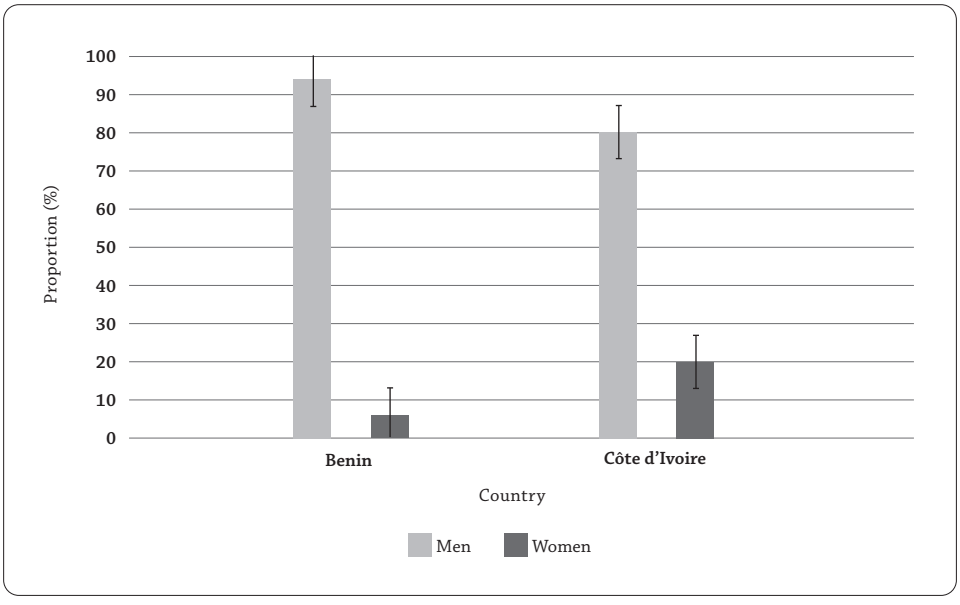
Table 3: Periodic statistics on projects funded by gender in agricultural science research teams in public universities in Benin, Niger and Côte d'Ivoire

Country	Men		Women	
	Number	Rate (%)	Number	Rate (%)
Benin	10	90.91	1	9.09
Côte d'Ivoire	20	66.67	10	33.33
Niger	8	80.00	2	20.00

Gender statistics on access to management positions

We then investigated university governance based on gender. We find university governance in Benin and Côte d'Ivoire is dominated by men (Figure 4). The proportion of women research professors in management positions in agricultural science schools, faculties or training units was 6.25% in Benin's public universities in 2023. This rate was 20% for all public universities in Côte d'Ivoire (Figure 4).

Figure 4: Gender distribution of the heads of training structures in public universities in Benin and Côte d'Ivoire in 2023



In the West African sub-region, efforts by leaders to reduce gender disparities (e.g. free education for girls in primary and secondary education, creation of the women's institute to support women in the school system and administration) are still insufficient, as revealed by statistics drawn from the figures presented in this document. Overall, women are underrepresented in higher education, with women representing less than 25% of the students enrolled in schools, faculties or training units dedicated to STEM focusing on agricultural sciences in 2023, in the public universities of Benin, Niger and Côte d'Ivoire.

Gender dynamics of enrolment and alumni suggest some progress towards gender equality in agricultural science in West Africa

To investigate whether enrolment and alumni trends show progress towards gender equality, we investigate trends over periods of six years or more (years vary based on country) for all three countries.

Over the period from 2005 to 2021, 14 701 female students were enrolled in agricultural science in Benin's public universities, compared with 60 586 male students. Women thus accounted for 19.53% of the total enrolment of 75 287. In Côte d'Ivoire's public universities, between 2012 and 2022, 1 083 female students were enrolled in agricultural science, compared with 2 966 male students. Women, therefore, accounted for 25.37% of the 39 750 enrolments. In Niger public universities, between 2015 and 2023, 839 female students were enrolled in agricultural science, compared with 4 346 male students. Women represent 16.18 % of the total student registration during this period.

Overall, female students were less represented than male students in agricultural science courses at public universities in Benin, Côte d'Ivoire and Niger. In Benin's public universities, from 2005 to 2011, the enrolment rate of female students in the bachelor's programme was higher than in the engineering, master's and PhD programmes (Figure 5). On the other hand, in the universities of Côte d'Ivoire, from 2012 to 2022, female student enrolment rates in the bachelor's and master's programmes were almost the same and higher than those in the engineer, DEA (Diplôme d'Études Approfondie) and PhD programmes (Figure 6). However, in Niger's universities from 2015 to 2023, female enrolment rates were higher for bachelor's degrees than for master's programmes (Figure 7).

Academic degrees in the African and Malagasy Council for Higher Education system refer to the number of years of formal study completed since obtaining the BAC (high degree certificate) qualification. Thus, there are Bachelor (BAC + 3 years of formal study), Master (BAC + 5 years of formal study) and PhD (BAC + 8 years of formal study) in the current system. In a former system, there were Bachelor (BAC + 3 years of formal study), Master 1 (BAC + 4 years of formal study), DEA/Engineer (BAC + 5 years of formal study) and PhD (BAC + 8 years of formal study).

Figure 8 shows the evolution of the gender parity index (number of female enrolments compared to male enrolment in a year) in public universities in Benin, Côte d'Ivoire and Niger. There has been a clear improvement in the ratio of female to male student enrolment per year in the bachelor's, master's and doctoral cycles for the 2018–2019 academic year in Benin's universities (Figure 8a). On the other hand, in the public universities of Côte d'Ivoire, this ratio varied between 2005 and 2011 for all training programmes, indicating variability and an imbalance to the detriment of female enrolment (Figure 8b). In public universities in Niger, the data show a significant gap in the gender parity index over time for two levels of study, with higher values for the bachelor's level. The enrolment of women at the master's level is very low (Figure 8c).

Figure 5: Proportion of women students enrolled in Benin universities in STEM focusing on agricultural science (Master = BAC + 5 and Master 1 = BAC + 4)

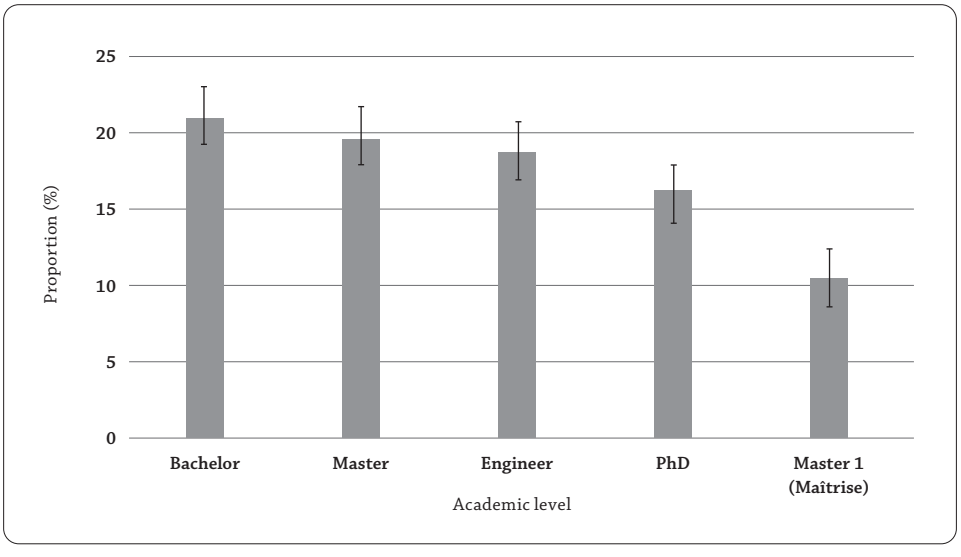


Figure 6: Proportion of women students enrolled in Côte d'Ivoire's universities in STEM focusing on agricultural science

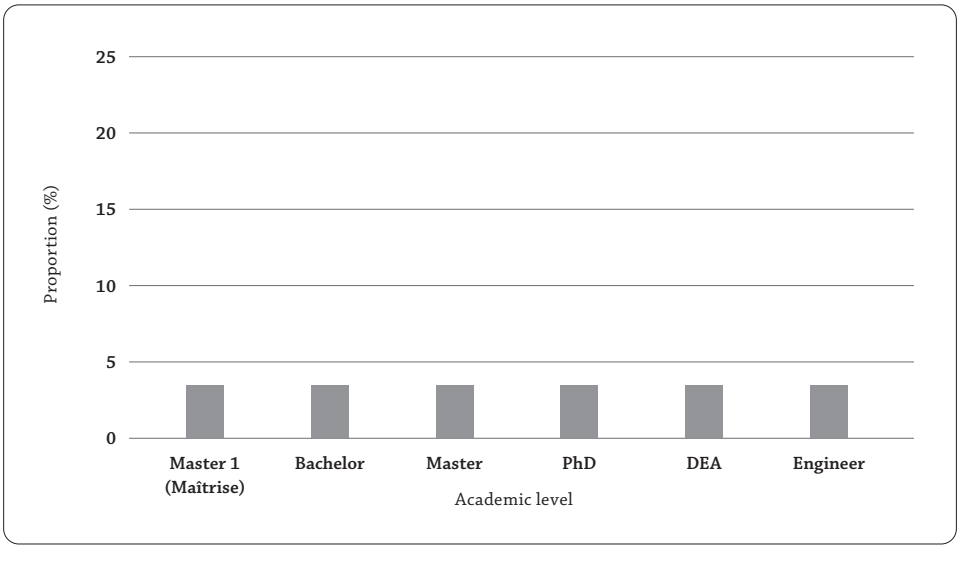


Figure 7: Proportion of women students enrolled in Niger's universities in STEM focusing on agricultural science

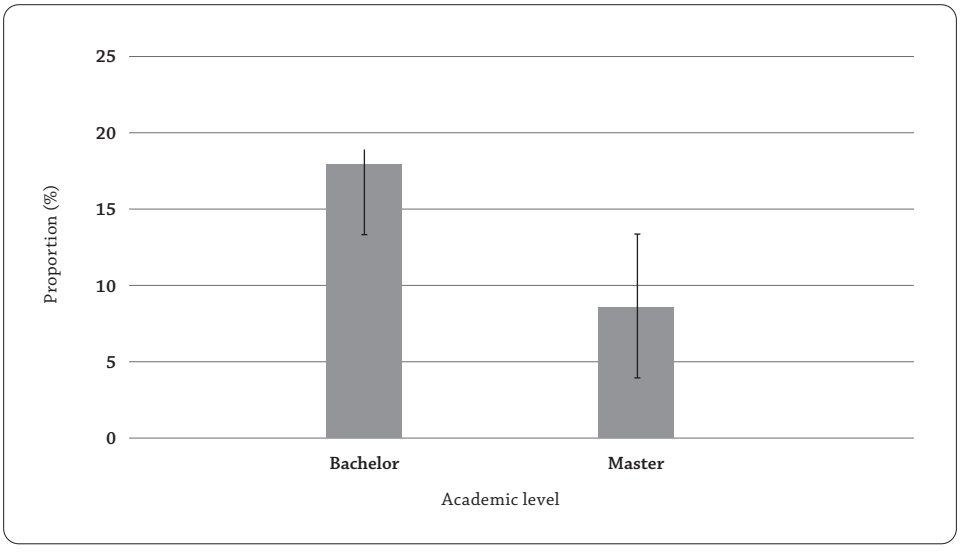


Figure 8 (a): Temporal evolution of the gender parity index of enrolment in Benin's national universities in agricultural science

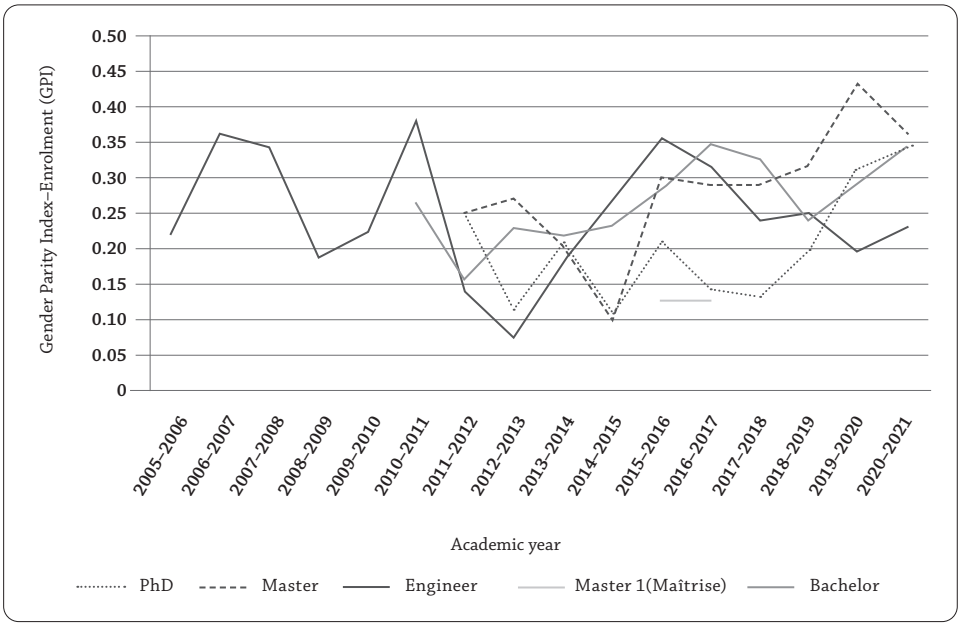


Figure 8 (b): Temporal evolution of the gender parity index of enrolment in Côte d'Ivoire's national universities in agricultural science

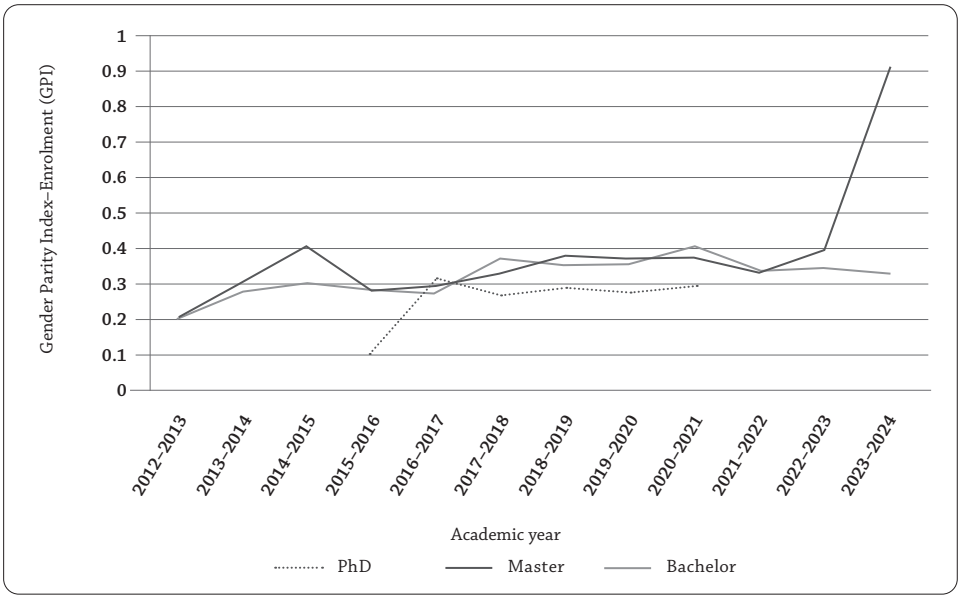
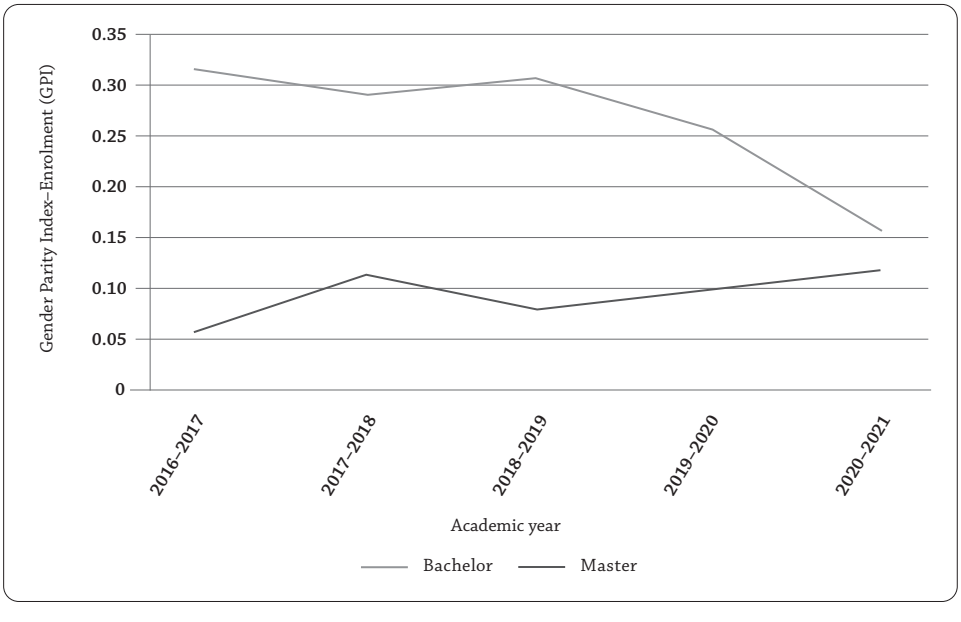


Figure 8 (c): Temporal evolution of the gender parity index of enrolment in Niger's national universities in agricultural science



Distribution and gender dynamics of alumni

Over the period from 2005 to 2021, 7 996 female students versus 28 939 male students were trained in agricultural science in Benin's public universities. Women accounted for 21.65% of the total of 36 935 students. In Côte d'Ivoire's public universities, from 2012 to 2022, 3 507 female versus 7 945 male students were trained in agricultural sciences, representing a proportion of 30.62% of women of a total of 11 452 students. In Niger's public universities, between 2016 and 2023, 346 female students versus 1 200 male students were qualifying in agricultural science. Women represent 23.83 % of the total number of students qualifying during this period.

In Benin's public universities, from 2005 to 2011, more female students were trained in the master's cycle than in the bachelor's, master's, engineer and doctorate cycles (Figure 9a). This could be explained by the fact that, in Benin, this period (2005–2011) corresponds with the first years of the creation of most of the master's programmes in agricultural sciences, which would have led to an engulfment not only of students in the normal programme, but also, and above all, of former undergraduates. On the other hand, in the universities of Côte d'Ivoire, from 2012 to 2022, the percentage of female undergraduate students was higher than that of female postgraduate students (Figure 9b). In the national universities of Niger, the qualification rate of females is higher for the bachelor's level than the master's level between the period from 2016 to 2023 (Figure 9c).

Figure 10 shows the evolution over time of the annual ratio of female student alumni to male student alumni, known as the gender parity index, in the public universities of Benin and Côte d'Ivoire. In Benin's universities, since the 2016–2017 academic year, there has been a clear improvement in the number of female students trained compared with male students each year in the bachelor's, master's and doctoral cycles (Figure 10a). In Côte d'Ivoire's public universities, on the other hand, this improvement has been noticeable since the 2021–2022 academic year. An opposite trend is observed in public universities in Niger, with a higher female presence at the bachelor's level than at the master's level over time. The trend observed in Benin can be explained by the free education for girls in primary and secondary education offered in 2006 for nursery and primary education, and in 2010 for secondary education, by the Benin government.

Figure 9 (a): Propotion of women students qualified in agricultural science in Benin's national universities

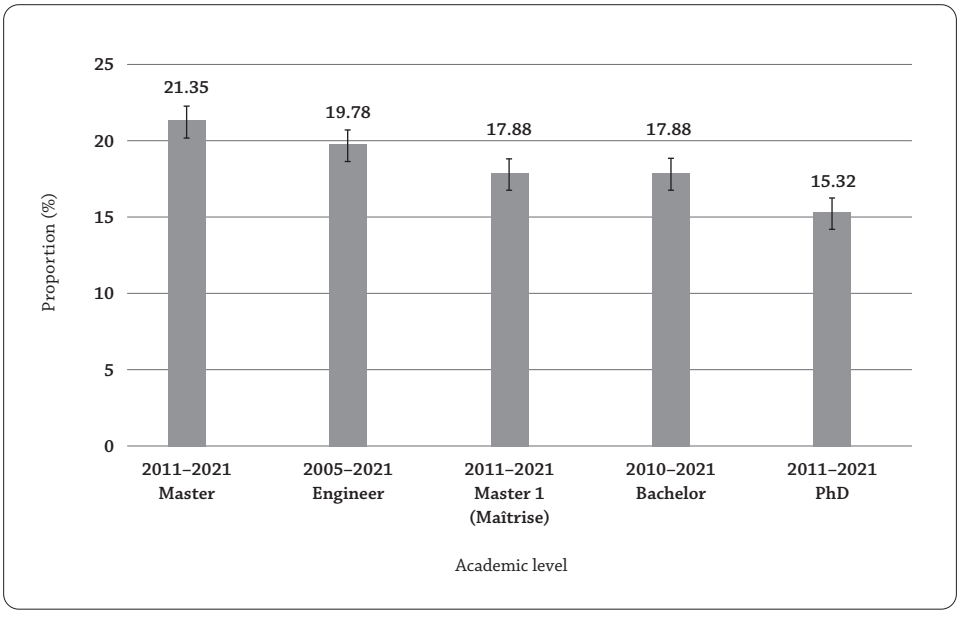


Figure 9 (b): Propotion of women students qualified in agricultural science in Côte d'Ivoire's national universities

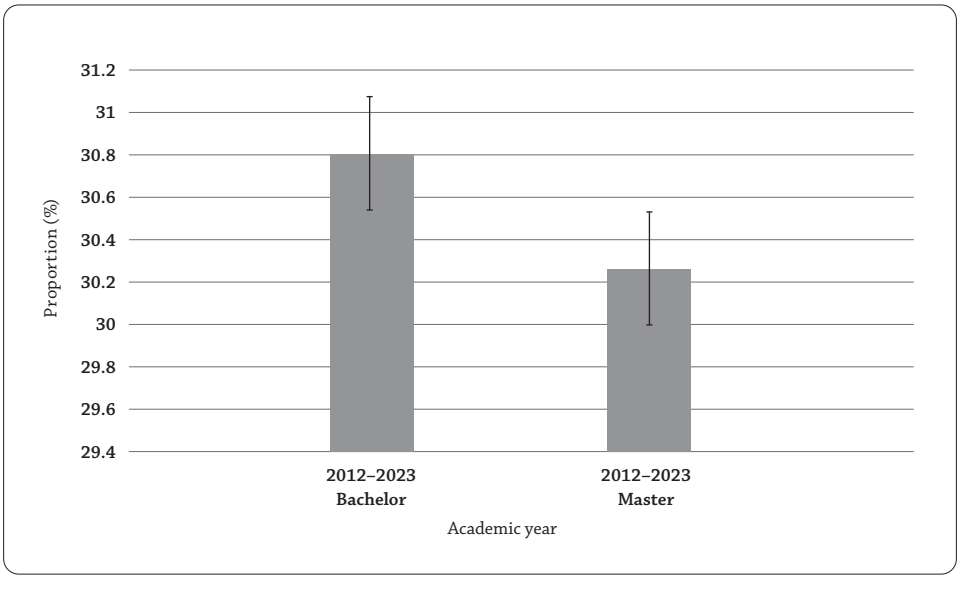


Figure 9 (c): Propotion of women students qualified in agricultural science in Niger's national universities

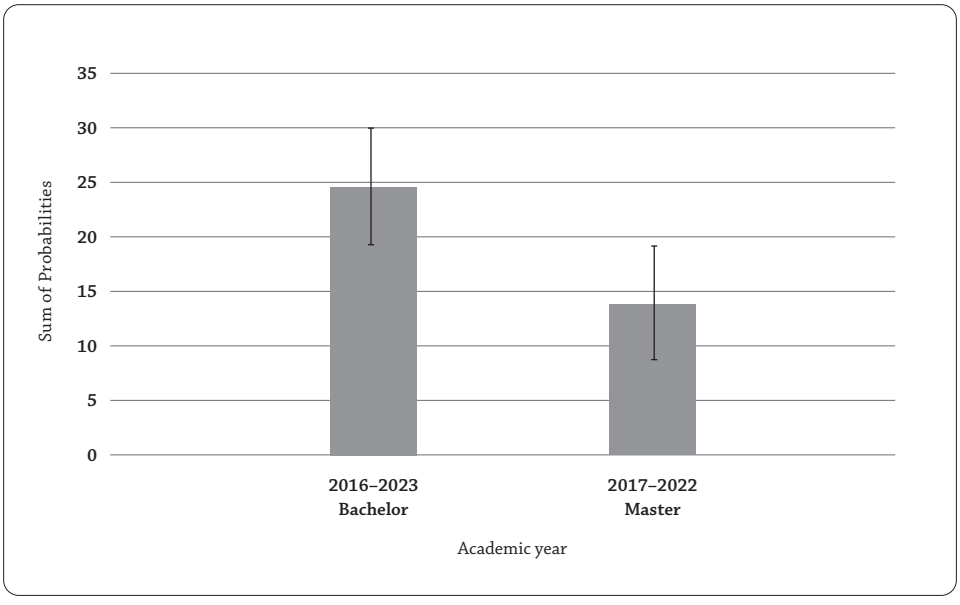


Figure 10 (a): Temporal evolution of the gender parity index of qualification in Benin's national universities in agricultural science

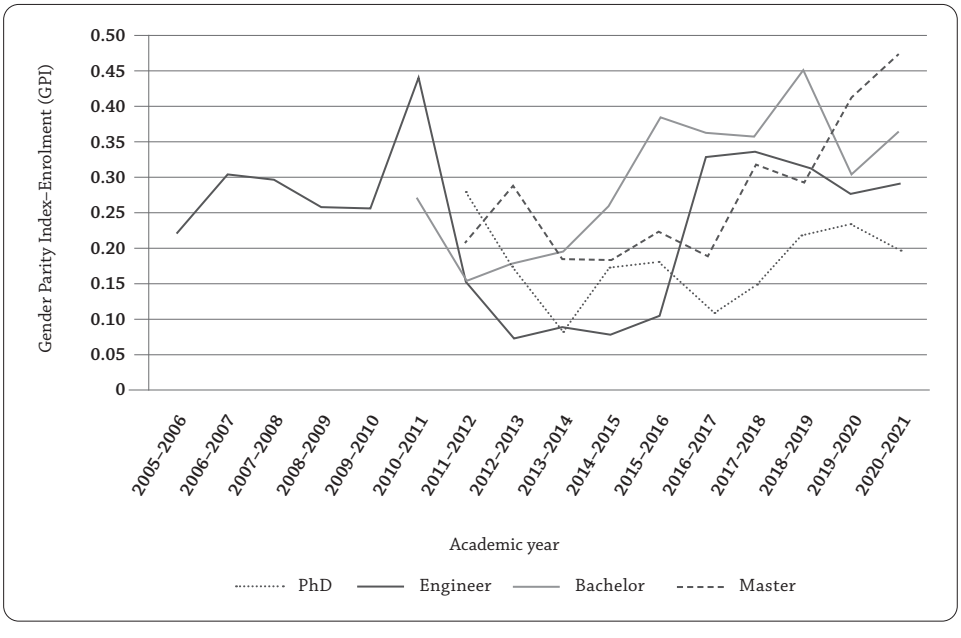


Figure 10 (b): Temporal evolution of the gender parity index of qualification in Côte d'Ivoire's national universities in agricultural science

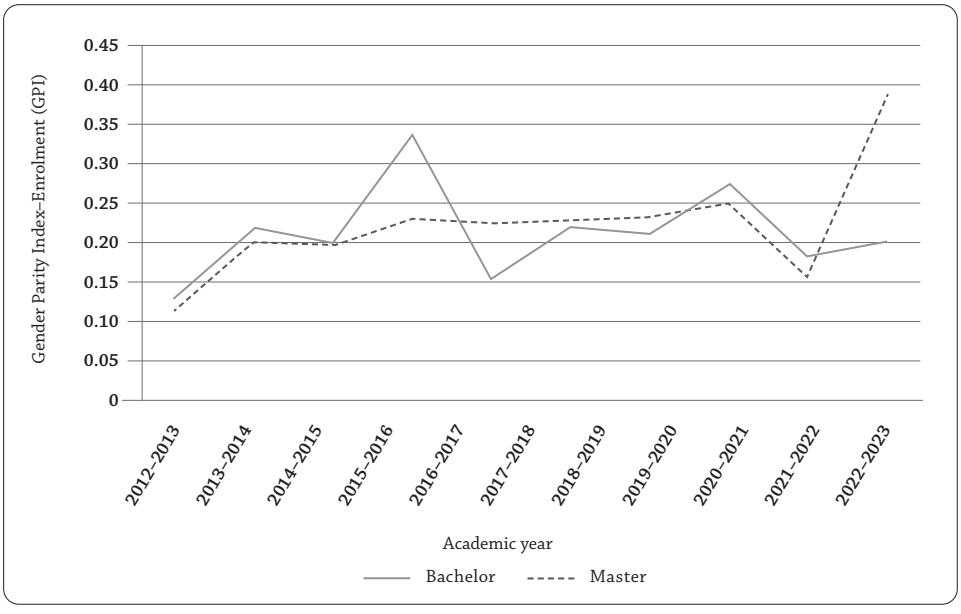
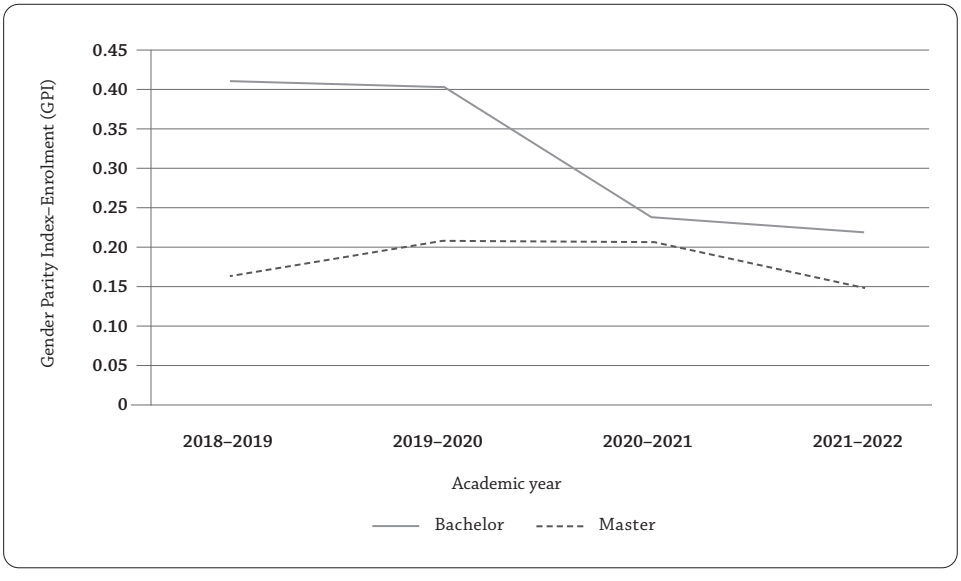


Figure 10 (c): Temporal evolution of the gender parity index of qualification in Niger's national universities in agricultural science



A range of complex factors are related to gender disparities in work and research

Gender disparities in work

To address Question 3a, we investigate gender disparities in agricultural work. While this question does not focus on agricultural research specifically, we argue that understanding gender disparities in agricultural work helps to ensure that researchers adequately consider gender in their research designs and data collection procedures. We further suggest that addressing inequalities in agricultural work may contribute to creating more inclusive environments, which could, in turn, encourage greater participation of women in agricultural research.

Women play crucial roles in processing and adding value to agricultural products, underscoring the importance of including both men and women in comprehensive agricultural data collection. However, biases may arise if interviewers lack an understanding of local socio-cultural norms, impacting the quality of responses obtained from farmers. Women's participation in data collection interviews is contingent upon the behaviour of data collectors and their adherence to socio-cultural norms, influencing men's decisions on allowing women to participate. As such, we highlight the most prevalent barriers to gender equality in agricultural work as shared by agricultural workers themselves. These include:

- **Land ownership disparity:** Women typically possess a limited share of land, ranging from 0.5 to 1 hectare, within their husbands' agricultural holdings. Moreover, men frequently assign infertile land to women following an extended period of farming. This is supported by the following statement made by a Benin woman and endorsed by others: "*my husband allowed me to farm one of his small plots which he has stopped using, it is less than a hectare in size and my harvests are often poor*". Despite empirical evidence indicating that equalising women's access to agricultural resources vis-à-vis men can lead to a significant 30% increase in agricultural yields (Doss et al., 2018), this unequal land distribution persists.
- **Women's fragility:** To the question "Do women perform all the tasks on their farms in the same way as men?" one male participant from Benin answered: "*There are certain activities that my wife can't do, such as ploughing, clearing land and applying pesticides. I often help her if I have the time, or*

she calls on the services of young people." Most of the other men agreed with these comments, as did most of the women.

These words show that women have historically been perceived as fragile individuals, often deemed incapable of engaging in various agricultural tasks such as ploughing, mowing, clearing, and applying herbicides and pesticides. Consequently, women were typically relegated to roles centred around harvesting, processing and trading agricultural products. This perception of women's fragility perpetuated by men has served as the foundation for the myriad challenges and obstacles women face in agriculture. Their empowerment becomes compromised when they rely on men to fulfil their basic livelihood requirements.

- **Socio-cultural factors linked to gender:** In response to the same question about women's fragility, some women from Benin assert:

  > *In our locality, tradition forbids women to carry out agricultural activities that keep them bent over for long periods, or that favour the passage of sand through their legs ... If a woman doesn't respect this prohibition, she risks losing her fertility, and most of us here believe in this*.

  This answer clearly reveals that, in some traditions, engaging in agricultural tasks that involve prolonged bending can potentially lead to health issues for women, as it is believed that this posture may cause the accumulation of air in the uterus, contributing to certain diseases. Additionally, there is cautionary advice for women to avoid allowing sand to pass through their legs.
- **Perceptions of pregnancy and maternity:** Women's biological condition is often viewed as a hindrance to engaging in agricultural activities, with men doubting their ability to manage large farms effectively.
- **Marital dynamics:** Traditional practices in various African countries, including Benin, dictate that married women relocate to their husbands' homes, leading to the belief that women cannot independently own farms. Inheritance for young women is often seen as a gift from their husbands, and any land they possess is considered the husband's property.
- **Limited access to farm labour and equipment:** To increase their labour for competitive production, women sometimes need to hire male labourers for some strenuous tasks like land clearing and ploughing, but men may not always provide satisfactory services. This leads to neglect of women's needs and potential exploitation.

- **Influence of tradition (patriarchal system):** Embedded in a patriarchal system, married women are expected to be subservient to their husbands in all aspects, including agricultural activities. Men may view women's agricultural pursuits as a challenge to their authority and may resist supporting them.

Limitations in research approaches contribute to gender-based inequalities in research

The participatory research synthesis (community-based research) also examined the potential sources of gender inequalities prevalent in agricultural science studies. Despite the lack of statistical correlation with sampling methods or obvious techniques well-known in the meta-analysis results, the process highlighted the complexities surrounding this issue. By carefully analysing the data, possible explanations and solutions gradually emerged, offering a roadmap for addressing these persistent disparities in the field. Through this deliberate exploration, a clearer understanding emerged, underscoring the importance of unpacking the underlying factors contributing to gender imbalances in agricultural science research.

Interviews with male and female farmers identified several factors associated with gender disparities in agricultural research and gathered approaches to solving these factors. These factors and their solutions are summarised below.

- **Patriarchal norms influence expression:** The patriarchal system often marginalises women's voices in public settings, leading to situations where women may be excluded from interviews without their input being sought. As a solution, questionnaires and data collection tools should explicitly require women's presence to provide their perspectives, and arrangements should be made to involve both farmers and their wives in household surveys.
- **Scope of surveys:** Some surveys tend to focus solely on household heads, neglecting the roles and insights of other household members. Potential solutions include appointments scheduled with both producers and their spouses for household surveys; questionnaires incorporating gender-related queries to capture diverse viewpoints; training programmes should sensitise investigators on the socio-cultural norms prevailing in the target communities before fieldwork commences; and efforts should be made to engage local data collectors familiar with the community context.

- **Education disparity:** The perception that women have higher illiteracy rates often leads to the biased selection of male participants for agricultural surveys, as reported by men. To overcome this challenge, the participation of both women and men farmers should be a key criterion in household selection for data collection, ensuring a more inclusive and representative data-gathering process.
- **Communication barriers:** Women often feel hesitant to speak openly in the presence of their husbands and may decline engagement with researchers. To face this challenge, initiatives should focus on raising awareness among women about the importance of their participation.
- **Selection of interviewers:** Interviewers sometimes overlook engaging with women, perceiving them as incapable or lacking knowledge of farming activities. As a solution, the involvement of both women and men should be a key criterion in selecting households for data collection.
- **Religious and gender considerations:** In certain religious contexts, interactions between men (especially strangers) and women may be restricted. It is therefore advisable to have female data collectors engage with women and male collectors with men during the acquisition of agricultural data, respecting religious norms and ensuring ease of communication.
- **Scheduling interviews:** Women's availability for interviews is often limited due to domestic responsibilities. In this case, data collectors could schedule interviews at times convenient for women, facilitating their active participation in data-collection processes.

Suggestions from farmers for gender-inclusive research methodology

Based on this case study, which has enabled us to gain a deeper understanding of the roots of gender disparities in agricultural research, several suggestions have been made directly by stakeholders in the agricultural world and beneficiaries of agricultural research results (i.e. farmers themselves) and are worthy of mention.

Proper structuring of questionnaires and data collection forms should mandate the presence of women to address specific inquiries. To emphasise the significance of women's involvement, data collectors should refrain from posing identical questions to both men and women. Biases in surveys incorporating gender aspects often stem from question formulation and the language used by data collectors to convey messages. Furthermore, farmers have highlighted their sensitivity towards gender-related topics, underscoring the importance

for researchers to carefully select appropriate wording when crafting questionnaires for gender-inclusive research.

Discussion

The various statistical results obtained relating to the gender distribution of teaching and research staff, positions of responsibility in training and research structures, and the composition of research teams and financed projects show a persistent disparity in the three West African countries, disadvantaging girls and women. This suggests that in Benin, Côte d'Ivoire and Niger, the issue of gender-based inequalities in agricultural sciences remains a major challenge (Question 1).

When considering the evolutionary dynamics of students enrolled and trained in the various fields of agricultural sciences at public universities, the results reveal a relative increase in girls/women statistics, albeit slight, between 2005 and 2021 in Benin, and between 2012 and 2023 in Côte d'Ivoire. This trend in the dynamics of the statistics suggests slight progress towards gender equality in the enrolment and training of female students in the agricultural sciences in these two West African countries (Question 2). This could be explained, in part, by the efforts of the governments of both countries to provide free nursery, primary and lower-secondary education.

Based on our findings, it is evident that gender inequalities in agricultural research and development in West Africa are shaped by a complex set of structural and cultural barriers (Question 3). Understanding these barriers is essential not only for promoting equality in agricultural work but also for informing more inclusive and context-sensitive research practices. Through our investigation, we have gained insights into barriers to equality in agricultural work as well as research. Though not the primary focus of this study, we want to emphasise the importance of increasing equality in agricultural work.

It is imperative to ensure that women have equal access to and ownership rights over agricultural land. This objective can be pursued through legal reforms and awareness campaigns that challenge the traditional notion of land ownership as a male prerogative. Furthermore, it is crucial to address the perception of women as fragile and incapable of engaging in specific agricultural tasks.

Training programmes should be established to equip women with the necessary skills and knowledge to participate in a broader spectrum of agricultural activities. Cultural beliefs and practices that hinder women's involvement in agriculture must be confronted. This can be achieved through community

dialogues, awareness campaigns and educational initiatives that challenge these entrenched norms and promote gender equality. To promote equal participation, women should have equal access to farm labour, equipment and agricultural services such as training, credit and extension support. This can be achieved through targeted programmes that address the specific needs and challenges faced by women in agriculture. Additionally, men should be educated about the benefits of gender equality and encouraged to support and empower women in agricultural endeavours. Finally, data-collection processes by researchers in agricultural science must be inclusive, capturing the experiences and perspectives of both men and women. Data collectors should be trained to be sensitive to gender issues, ensuring that women's voices are adequately represented in the research and development process.

Farmers' observations of these inequalities have highlighted notable biases in the sampling methodologies that are commonly employed in agricultural studies, which frequently lead to the exclusion of certain gender groups from the resulting research outcomes and from the dissemination of agricultural technology innovations. The gender of the researcher or data collector, as well as the process of gathering agricultural data from farmers, introduces additional sources of bias into data collection and subsequent analysis. Societal norms often impede access for male data collectors to obtain information from female farmers during surveys, necessitating respectful adherence to local socio-cultural norms and practices throughout the research process. Addressing the identified disparities voiced by both male and female farmers, proposed solutions centre on five key points: (1) structuring questionnaires and data collection forms to mandate women's participation is explicitly required in specific responses; (2) scheduling household surveys to include both farmers and their spouses to capture a more complete household perspective; (3) incorporating local individuals among data collectors to improve familiarity and trust within communities; (4) facilitating gender-congruent interactions in agricultural data collection by pairing women farmers with female data collectors and male farmers with male counterparts; and (5) coordinating interview timings based on women's availability to enhance their engagement and provide equitable opportunities to participate.

The solutions advocated by farmers call for the implementation of tailored approaches in designing agricultural research protocols and the execution of field surveys. These strategies encompass the adoption of statistically robust sampling techniques to ensure the inclusive representation of women, men and all marginalised groups among the target populations in research endeavours,

thereby supporting more accurate, equitable and applicable findings across the agricultural sector.

Conclusion

Women are still underrepresented in agricultural sciences in Benin, Côte d'Ivoire and Niger, with some variations in the statistics from one country to another. This underrepresentation is quite pronounced in both the categories of registered learners and graduates. The same is true for teaching staff in public universities, in the governance of universities and their structures, within research teams, and for leadership in drafting and coordinating research projects. It should be noted, however, that the lack of a database on the gender distribution of disaggregated statistics in several universities and research centres in West Africa may be a limitation in assessing the evolutionary trend of these statistics.

Gender disparities serve as substantial impediments to progress and development within societies. As a result, it is imperative that scientific investigations, often utilised to devise solutions and innovations, are meticulously structured to mitigate any inherent gender biases in their methodological frameworks. To facilitate the attainment of research outcomes conducive to establishing comprehensive and participatory solutions and technologies, this study has elucidated various facets of agricultural research that contribute to gender inequalities, pinpointing the associated factors and strategies for curtailing such biases. The disparities identified within agricultural research encompass socio-demographic considerations, such as cultural norms and land ownership practices, biological elements including pregnancy and maternity concerns, and organisational or institutional factors like the structuring of surveys, survey design and the recruitment of interviewers. By considering these barriers and implementing these recommendations, researchers are encouraged to critically engage with and reduce gender bias in their work, ensuring that gender perspectives are meaningfully integrated, an essential step towards fostering inclusive and sustainable development.

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