Chiche *et al. CABI Agriculture and Bioscience* (2024) 5:97
https://doi.org/10.1186/s43170-024-00280-9

CABI Agriculture and Bioscience

RESEARCH

Open Access

Gender analysis of chickpea (*Cicer arietinum*) yield gap: the case of Ada'a, Ethiopia

Wubishet Chiche[1*], Dagne Mojo[1] and Esubalew Abate[2]

Abstract

One of the primary development challenges hindering poverty reduction in Africa is the existence of a yield gap between female and male farmers. However, previous studies conducted in Ethiopia have largely overlooked the role of gender-related factors in influencing this gap. This article aims to address this gap by examining the chickpea yield disparity between female and male farmers and identifying its determinants. Data were gathered from 325 respondents (163 male and 162 female farmers) in 2019, combining survey responses with qualitative insights from discussions in two women farmers' groups, two men farmers' groups, and four key informant interviews. T-tests and linear regression models were applied to quantify the extent of the yield gap and analyze the factors contributing to it. Additionally, thematic analysis of the qualitative data was conducted to complement the quantitative findings. The study revealed that female farmers produced 29% less chickpea yield in the 2019 production year compared to their male counterparts, and this difference was statistically significant. Factors such as land allocation for chickpea cultivation, soil fertility, labor availability, chickpea variety (improved or local), access to extension services, and participation in farmers' cooperatives were identified as significant contributors to the yield gap. Beyond these technical aspects, gender-related challenges like unequal treatment, restricted mobility, labor demands, and religious/cultural taboos were also factors impeding the productivity of women farmers. Addressing the yield gap necessitates an inclusive approach in all agricultural development endeavors, recognizing and rectifying gender-based disparities to enhance the productivity and livelihoods of female farmers.

Keywords Gender, Men, Women, Regression, Yield

Introduction

According to the Food and Agriculture Organization (FAO) (2018), women account for approximately 43% of the agricultural labor force in developing countries. In Ethiopia, it is estimated that women contribute between 60 and 80% of the agricultural workforce. Mulema and Damtew (2016) further highlight that women farmers play a significant role in producing over half of the world's food; however, they often encounter difficulties accessing resources like land, credit, inputs, and technology compared to men. Tesfaye (2020) noted that Ethiopian women participate in various agricultural activities, such as crop cultivation, livestock management, and post-harvest processing. Despite their contributions, they encounter obstacles such as limited land rights, restricted access to financial services, and inadequate agricultural extension services.

Studies indicate substantial variations in agricultural productivity between female and male farmers both across and within countries in Sub-Saharan Africa. Gebre et al. (2021) observed a 20 to 30% gap in agricultural productivity between female-headed and male-headed households throughout Sub-Saharan African nations. In Ethiopia, a significant yield disparity was noted, with women farmers achieving output values per hectare 35%

*Correspondence:
Wubishet Chiche
chichewub21@gmail.com
[1] Ethiopian Institute of Agricultural Research (EIAR), Debre Zeit Agricultural Research Center (DZARC), Bishoftu, Ethiopia
[2] Addis Ababa Universities, Addis Ababa, Ethiopia

lower than their male counterparts, as highlighted by Tiruneh et al. (2001).

Peterman (2011) also found that plots managed by women had lower productivity compared to those managed by men, even when household-level unobservable factors were taken into account. Moreover, Pender and Gebremedhin (2006) reported that despite similar levels of labor, ox power, and FAO (2014) other inputs, women achieved crop yields 42% lower than their male counterparts, highlighting a gender-based disadvantage in input utilization. Additionally, Mugisha et al. (2019) noted that societal gender roles restrict women's production and marketing opportunities, leading to a comparative disadvantage in cultivating improved varieties over less productive ones. In essence, the yield disparity between female and male-headed households stands as a significant developmental hurdle, impeding efforts to alleviate poverty in Africa (African Development Bank Group 2015).

Efforts have been made globally and in Ethiopia to address the gender gap in agriculture. Doss (2018) emphasized that providing women farmers with access to resources, technology, and extension services has proven effective in increasing their productivity and reducing the yield gap on a global scale. In Ethiopia, as noted by Tesfaye (2020), ongoing initiatives are focused on addressing challenges and empowering women in agriculture. The government has implemented various policies and programs, such as the National Gender Policy and the Agricultural Sector Development Program, to promote gender equality in the sector. Furthermore, organizations and NGOs are actively involved in offering women training, access to resources, and market linkages to enhance their productivity and income in agriculture. Despite these efforts, the yield gap between women and men farmers persists both globally and specifically in Ethiopia.

Many studies conducted in Ethiopia have highlighted that technical factors play a significant role in the productivity of farmers regardless of gender. For example, a study by Tiruneh et al. (2001) suggested that the productivity of female and male farmers is influenced by the agricultural inputs they utilize. Similarly, another study identified poor agronomic practices, the limited yield potential of local chickpea varieties, and restricted access to improved varieties as factors contributing to the low productivity of chickpeas at the farmers' level (Fikre 2014). While some studies focused solely on technical factors without considering gender-related aspects in yield disparities, others examined both. For instance, Peterman (2011) and Pender and Gebremedhin (2006) discussed how gender-related factors, along with technical abilities and inputs, affect the lower productivity of women. Mugisha et al. (2019) emphasized that gender yield gaps are largely a result of unexplained gender inequalities within communities, stemming from societal norms, practices, and beliefs.

Chickpea has been selected for analyzing yield gaps due to several factors: its expanding acreage, cost-effectiveness (with a 60% reduction in fertilizer costs), higher returns compared to cereal crops such as tef, and lower labor requirements than cereal crops (Girma 2010). Consequently, this study aims to evaluate the disparity in chickpea yield between women and men farmers and identify the factors influencing this gap. What distinguishes this research from previous studies in Ethiopia is its comprehensive examination of both technical and gender-related factors that impact women's productivity.

Material and methods

This study was carried out in Ada'a Woreda, located in the Oromia regional state of Ethiopia as shown in Fig. 1. The region is situated in the central highlands of the country and experiences a tepid to cool sub-moist climate. The area predominantly consists of heavy soils known as Vertisols. Key crops cultivated in the region include tef, wheat, barley, faba beans, chickpeas, and lentils. Ada'a Woreda comprises 25 rural kebeles and a total population of 133,205 individuals, with 69,447 males and 63,758 females. Among the 20,362 households in the area, 1912 are headed by females, while 18,450 are headed by males (CSA 2005).

From twenty five rural kebeles, three kebeles (Akako, Tullu Dimtu, and Denkaka) were selected using a multistage sampling method. A total of 325 (163 MHHs and 162 FHHs) households were participated in household survey. Yemane's sample size determination formula was used to determine the sample size (Naing 2003). Household survey and focus group discussion participants were selected using simple random sampling and key informants were selected purposively. Srinivasan (2019) emphasized the importance of considering various resources when organizing focus groups, such as time, budget, facilitation capacity, and the study's objectives. To facilitate more in-depth discussions and enhance participant engagement, it was suggested that 6–8 participants per group be included. Therefore, for this study, group discussions were conducted with six participants in each group, two women and two men groups. The research utilized both primary and secondary data sources. Primary data were collected through face-to-face interviews, Focus Group Discussions (FGDs), and Key Informant Interviews (KIIs) with selected participants. In addition, secondary sources like books, journal articles, and internal records were consulted. An independent sample t-test was employed to determine if there was

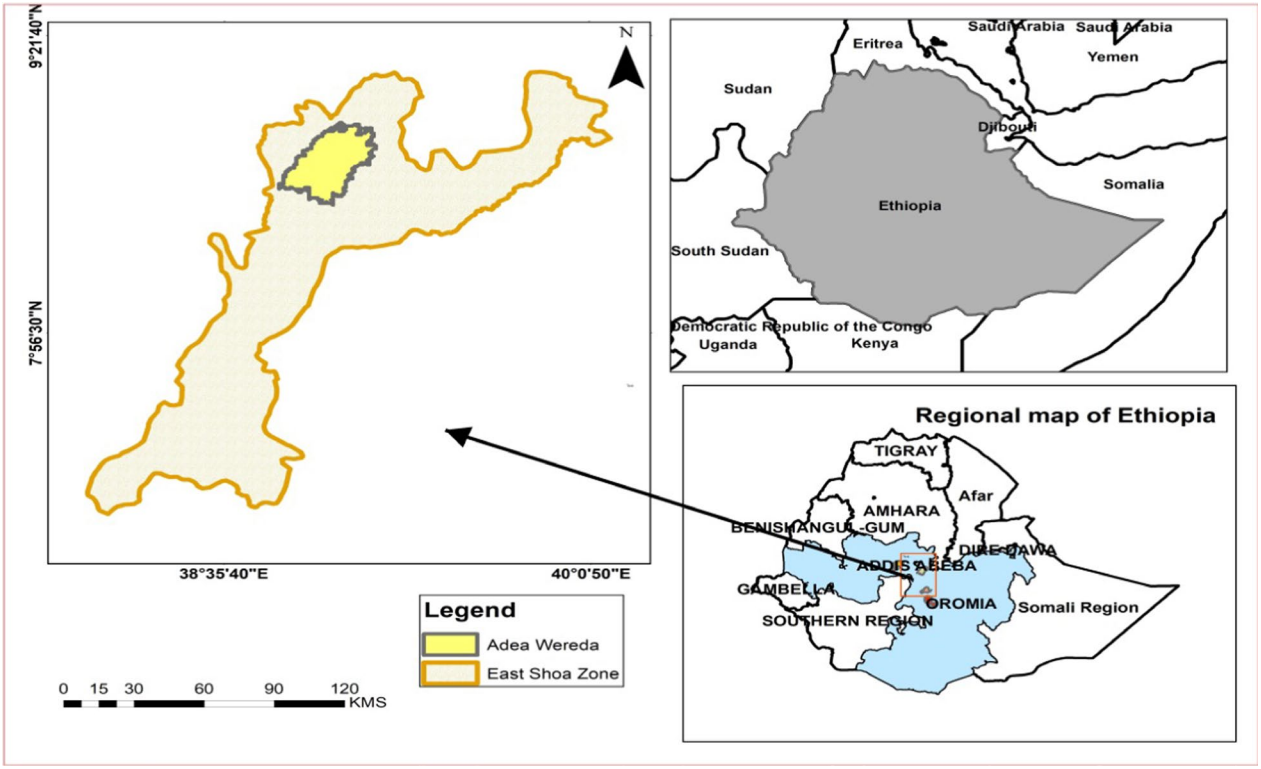

Fig. 1 Location map of study area

a statistically significant difference in yield between the two groups based on their mean scores.

Various factors contributing to the yield gap between women and men farmers have been identified in literature. Kassam et al. (2018) highlighted the importance of factors such as access to resources, knowledge, and decision-making power in agricultural contexts, while Doss (2018) underscored that limited access to land and technology also play a role in the yield disparity between female and male farmers. In Ethiopia, Tiruneh et al. (2001) discovered that the productivity of women and male farmers is influenced by factors such as age, labor, farm size, livestock units, the use of inorganic fertilizers, and extension services. Fikre (2014)pointed out that inadequate agronomic practice, low yield potential of local varieties, and limited access to improved chickpea varieties are reasons for the low productivity of chickpeas among farmers. Additionally, Peterman (2011) and Pender and Gebremedhin (2006) highlighted the impact of gender-related factors, alongside technical abilities and inputs, on the reduced productivity of women in agriculture. Mugisha et al. (2019) emphasized that gender yield gaps often stem from unexplained inequalities within communities, influenced by social norms, practices, and beliefs. By considering the findings from various studies conducted both internationally and in Ethiopia, these explanatory factors were incorporated into a linear regression model, as shown in Eq. 1 below.

$$Y = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \ldots \beta_{12} x_{121} + \varepsilon_{12} \quad (1)$$

where: Y = Chickpea yield in kg/ha, x_1 = Age, x_2 = Education, x_3 = Land size, x_4 = Labor resources, x_5 = Type of chickpea produced, x_6 = Soil fertility, x_7 = Frequency of plough, x_8 = Keeping from birds and thief, x_9 = Chemical application, x_10 = Farmers' association membership, x_11 = Extension services, x_12 = Number of oxen owned, β_o = constant/intercept, ε = Residual or Error term.

Prior to conducting the regression analysis, the presence of collinearity among the independent variables was assessed. Table 1 displays the results of the multicollinearity test for the independent variables at significance levels of 1%, 5%, and 10%. The variance inflation factor (VIF) was utilized to measure the extent to which the variance of the estimated regression coefficient is inflated in the presence of correlations among the independent variables. As per Belsley (1990), a VIF value of 1 indicates no correlation among variables. In this study, the VIF values for the independent variables were found to be 1, suggesting that the regression coefficients exhibit no

Table 1 collinearity statistics of independent variables

Model		Coefficients[a]						
		Unstandardized coefficients		Standardized coefficients	t	Sig	Collinearity statistics	
		B	Std. error	Beta			Tolerance	VIF
1	(Constant)	4065.674	382.817		10.620	< .001		
	Sex	− 272.546	161.786	− .108	− 1.685	.093	.753	1.287
	Age	− 596.39***	100.770	− .309	− 5.918	< .001	.759	1.318
	Education	39.87	54.945	.035	.726	.469	.883	1.132
	Land allocated for chickpea in 2011/12	− 395.63***	163.546	− .122	− 2.419	.016	.808	1.238
	Labor resources	213.072	126.315	.083	1.687	.093	.852	1.174
	Type of chickpea produced in 2011/12	− 35.643	131.763	− .014	− .271	.787	.826	1.210
	Fertility of Chickpea land	− 650.95***	148.402	− .223	− 4.386	< .001	.799	1.251
	Frequency plough	− 297.35***	69.922	− .202	− 4.253	< .001	.917	1.091
	Keep chickpea	− 90.050	124.374	− .035	− .724	.470	.864	1.158
	Chemical use	321.209	616.020	.024	.521	.602	.949	1.054
	Ox ownership	94.51**	39.415	.132	2.398	.017	.685	1.460
	Membership of farmers' association	− 451.40***	160.848	− .171	− 2.806	.005	.974	1.038
	Extension services	− 832.201	137.23***	− .328	− 6.064	< .001	.756	1.148

[a] Dependent Variable: total amount of chickpea produced per allocated land in 2011/12 in kg

*** = Significance at $p < 0.01$, ** = Significance at $p < 0.05$, * = Significance at $p < 0.1$

correlation and have a strong influence on the dependent variable.

Results and discussions

Summary of demographic and socioeconomic characteristics

According to the data presented in Table 2, a higher percentage of women in the study area, 27.4%, are unable to read and write compared to men. Conversely, a larger proportion of men, exceeding their female counterparts by 27.4%, participated in adult education programs. In terms of household amenities, 79% of men and 96% of women reside in houses with tin roofs, reflecting the predominant living conditions in the area.

In 2019, the average income derived from crop sales differed significantly between men and women in the study area. Men's average income was recorded at 33,069.94 ETB, whereas women earned 13,434.90 ETB, indicating a notable income disparity of 19,635 ETB (41%). The household survey also revealed stark discrepancies in decision-making regarding chickpea sales income: 85.4% of men made the decisions solely, 14% shared the decision-making with their wives, and less than 1% was solely made by the wife. This imbalance underscores the unequal decision-making power women have in managing agricultural sales income compared to men. Conversely, female heads of households enjoyed full autonomy in decision-making on income derived from crop sales. Furthermore, insights from the interviews highlighted that households predominantly relied on a combination of family and hired labor for chickpea harvesting and threshing. Women utilized family labor for 32% of the work, while men relied on it for 41%, signifying an 11% higher utilization by men. Additionally, women employed bought labor for 68% of the harvesting, compared to 59% for men, indicating a 9% higher reliance on bought labor by women.

In the study area, men possessed higher percentages of various assets compared to women. Specifically, men owned mobile phones, solar power systems, functional radios, carts, and motor pumps at rates 30%, 11%, 21%, 14%, and 2.5% higher than women, as detailed in Table 2. Interestingly, both male and female household heads owned knapsack sprayers in equal measure, at 44%. In contrast, women lacked ownership of certain assets such as electricity, bio-gas facilities, and functional televisions. Conversely, a small fraction of men, 0.6%, 2.5%, and 3.7% respectively, possessed these assets.

Estimated yield gap

As observed in Table 3, in Ada'a district, the average chickpea yield for male farmers stood at 1798 kg/ha in the 2019 production season, while female farmers recorded an average yield of 1287 kg/ha. This discrepancy reveals a mean yield difference, or yield gap, of 511 kg/ha, representing a notable 29% difference between women and men farmers. The independent sample test results showed a p-value of $P = 0.000$, which is less than 0.05.

Table 2 Summary of demographic and socioeconomic characteristics

		Men	Women
Educational Background	Unable to read and write	30%	57.4%
	Adult education and above	70%	42.6%
Household amenities	Tin roofed	79%	96%
	Other type of house	21%	4%
Economic benefits and decision making on income	Income from crop sell in 2019	33,069.94 ETB	13,434.90 ETB
	Significant difference of income	19,635 ETB (41%)	
	Head alone	85.4%	100%
	Wife in MHHs	13.9%	
	Both wife and husband	0.6%	
Means of harvest and thresh chickpea	Bought labor	59%	68%
	Family labor	41%	32%
Assets ownership	Mobile	86%	56%
	Electricity	0.6%	0%
	Solar power	55%	46%
	Knapsack Sprayer	44%	44%
	Bio-gas	2.5%	0%
	Functional radio	64%	45%
	Functional TV	3.7%	0%
	Cart	15.3%	1.2%
	Motor pipe	3.1%	0.6%
	Motor pipe	3.1%	0.6%

Table 3 Independent samples test of yield gap between men and women in Ada'a woreda

	Sex of the respondent	N	Mean	Std. deviation	Std. error mean
Total amount of chickpea produced per hectare in 2019 in kg	Male	163	1798	1324.48	103.74
	Female	162	1287	1151.62	90.48

This statistical significance indicates that women farmers had a significantly lower chickpea yield per hectare compared to their male counterparts, with a difference of 511 kg/ha.

Factors affecting yield gaps between men and women farmers

As observed in Table 3, in Ada'a district, the average chickpea yield for male farmers stood at 1798 kg/ha in the 2019 production season, while female farmers recorded an average yield of 1287 kg/ha. This difference reveals a mean yield difference, or yield gap, of 511 kg/ha, representing a notable 29% difference between women and men farmers. The independent sample test results showed a p value of $P = 0.000$, which is less than 0.05. This statistical significance indicates that women farmers had a significantly lower chickpea yield per hectare compared to their male counterparts, with a difference of 511 kg/ha.

In the model summary, the parameter R indicates the level of prediction by independent variables, while R-squared (R^2) signifies the percentage of explanatory variables influencing the variability in chickpea yield per hectare. For women and men, the values of R were 0.674 and 0.846, respectively, indicating a good level of prediction of total chickpea yield based on the independent variables. The R^2 values for female and male farmers were 0.595 (59.5%) and 0.820 (82%), respectively. This suggests that 59.5% of women's chickpea yield and 82% of men's chickpea yield were influenced by the explanatory variables included in the model. The relatively lower percentage for women (59.5%) implies that there may be other variables not accounted for in the model that influence women's productivity in addition to the estimated variables.

Factors that significantly contribute to the yield gap between women and men farmers include land size, labor resources, type of chickpea produced (improved or local), soil fertility, number of oxen owned, membership in farmers' cooperatives, and extension services, as outlined in

Table 3. The negative sign in the model coefficients signifies a negative relationship with the dependent variable, while the positive sign indicates a positive relationship. Specifically, land size, soil fertility, and extension services exhibit negative relationships with chickpea output per hectare, while labor resources, type of chickpea produced, and membership in farmers' cooperatives show a positive relationship with chickpea output per hectare. Table 4 data reveals that for every unit increase in land size, soil fertility, and extension services, chickpea yield per hectare decreases by 1676.4, 449.568, and 72.372 units, respectively. Conversely, a unit increase in labor resources, the use of improved chickpea seeds, and membership in farmers' cooperatives leads to an increase in chickpea yield per hectare by 595.359, 339.282, and 554.484 units, respectively.

Qualitative analysis

The qualitative data collected through Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) were analyzed using thematic analysis and summarized as follows. In terms of the treatment development agents provide for women and men farmers, the women's group indicated that they had not received any services and were not familiar with the development agents personally. They mentioned that it is mostly men who are contacted for extension services and invited to participate in such programs. The women expressed that they rely on daily sustenance, trusting in divine providence, and often live a hand-to-mouth existence. Additionally, they emphasized that they lack information about various development activities taking place in their community.

In terms of farmers' access to improved technology, the women's group highlighted that men have more frequent access to extension services and acquire information through various channels such as visiting distant markets, attending training sessions, using mobile phone contacts, leveraging their social status, connections, friendships, and interactions at local social gatherings. They explained that societal norms discourage women from venturing far from their village and spending extended periods away from home.

On the other hand, the men stated that training sessions in their community are not regularly or frequently organized. The trainings often do not align with their free time or occur during the off-season. They mentioned that most training scheduled in July and August, coinciding with the peak agricultural season when they are extremely occupied. Despite this, they compromise their activities to attend these trainings, recognizing the value of the opportunity. The men expressed that the location of the training sessions is not an issue for them, as the organizing body covers their expenses.

Land size

Land is a pivotal asset for farmers' livelihoods, serving as the primary source of income for most agricultural practitioners. It significantly influences the overall wealth of farmers. As depicted in Fig. 1 below, the average landholding per household head in Ada'a district is 1.7 hectares. Specifically, male farmers own an average of 2.04 hectares, whereas female farmers own an average of 1.2 hectares. This data reveals that, in Ada'a district, men possess, on average, 0.84 hectares more land than their female counterparts.

Duffy (2009) highlighted that larger land sizes often result in economies of scale, enabling farmers to distribute fixed costs across a broader area, thus enhancing operational efficiency. This phenomenon can lead to increased productivity and profitability for farmers. Consequently, research findings suggest that the size of land holdings has a negative correlation with yield, implying that smaller landholdings among women in the study area may hinder their agricultural output.

Extension contact

Having access to extension agents is crucial for farmers to receive updated information and adopt new agricultural technologies that can enhance their production levels.

Table 4 Estimated model coefficients for chickpea yield

	Unstandardized coefficients		Standardized coefficients	t	Sig
	B	Std. error	Beta		
(Constant)	4971.655	614.41		8.092	0.00
Land size	−1676.362	449.617	−0.268	−3.728	0.00
Labor resources	595.359	178.293	0.255	3.339	0.001
Type of chickpea is produced	339.282	175.508	0.143	1.933	0.044
Soil fertility	−449.568	173.472	−0.183	−2.592	0.011
Membership farmers' coop	554.484	218.494	0.2	2.538	0.012
Extension services	−72.372	215.306	−0.28	−3.123	0.002

Danso-Abbeam et al. (2018) emphasized that extension services serve as a vital source of information on innovative farming techniques, which, when implemented, can lead to improved production, increased incomes, and elevated living standards within farming communities.

Women expressed a lower level of contact with extension services compared to their male counterparts. During Focus Group Discussions (FGDs), it was revealed that one of the primary reasons for this disparity is the unequal treatment of development workers towards women and men farmers. Women farmers reported a lack of communication with development agents in their kebele and admitted to not knowing them personally. They noted that extension services often prioritize male farmers and model female farmers. Key informants highlighted that model farmers are predominantly selected for extension services by development workers, reinforcing the perception that male farmers are viewed as "strong" and women as "weak." This bias results in women farmers receiving fewer extension services, hindering their potential for increased production and productivity.

Continuously targeting the same type of farmers for extension services may not lead to sustainable agricultural development. It is essential to create an enabling environment that elevates all farmers to the status of model farmers through consistent and inclusive extension contacts and training. The dissatisfaction levels among women and men farmers regarding the extension services in Ada'a Woreda are significant, with 96.7% of women and 89.6% of men expressing dissatisfaction. This indicates a widespread discomfort with the current delivery of extension services in the area.

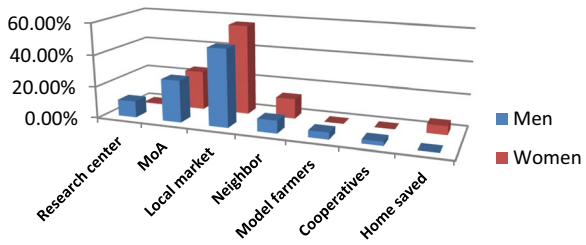

Fig. 2 Source of chickpea seed for women and men

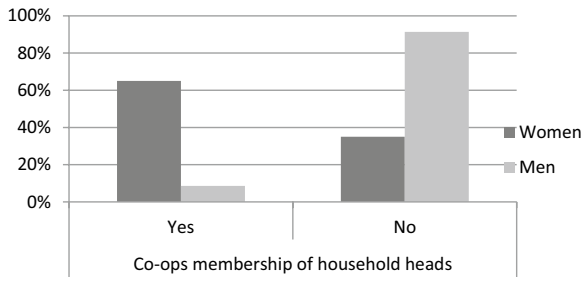

Fig. 3 Farmers seed cooperative memberships

Type and sources of chickpea seed produced

In Ada'a Woreda, 62.5% of women cultivated improved chickpea varieties, while 37.5% grew local types. Conversely, 64.2% of men planted improved varieties, with 35.8% opting for local types. This data indicates that both women and men farmers had access to improved seeds in Ada'a Woreda, highlighting the importance of utilizing improved crop varieties to boost yield. However, the critical question is: where do farmers access these improved seeds? According to Fig. 2, a significant proportion of women sourced their seeds from informal sectors such as the local market, neighbors, and saved seeds from previous harvests. In contrast, men primarily obtained their seeds from formal channels like research institutions, the Ministry of Agriculture, and local markets. The disparity in seed sources may be a contributing factor to the lower yields experienced by women farmers in Ada'a Woreda.

Kotu and Assefa (2015) also noted that adopting improved agricultural technologies positively impacts yield, income, food security, and poverty levels. The challenges faced by most women farmers in accessing seeds from formal sources were unveiled during Focus Group Discussions. Factors such as limited extension contact, lack of information dissemination through various channels (e.g., distance to markets, training opportunities, mobile phone access, social standing in the community, relationships, and social gatherings) impede their ability to acquire quality seeds. Gender-based constraints, including restricted mobility and societal expectations that confine women to domestic responsibilities, further hinder their access to formal seed sources.

Membership in farmers' cooperatives

As depicted in Fig. 3, the majority of women (91.4%) in the study area are not members of farmers' cooperatives, contrasting sharply with the 65% membership rate among men. Feedback from various Focus Group Discussions with women reveals that the criteria set by cooperatives tend to exclude women from membership, with women perceiving them as gender-biased and non-inclusive. They noted that the few women who are members often gained membership either their late husbands were member or could not attend because of health related problems, and model women. The absence of women in farmers' cooperatives deprives them of crucial benefits such as access to improved seeds, training, and timely agricultural inputs. Consequently, this disparity contributes to lower yields compared to their male counterparts in Ada'a Woreda.

Soil fertility

In the study area, it was observed that 82% of women's land and 68% of men's land were considered infertile. Moreover, when comparing the fertility of chickpea plots between households, it was evident that men's plots were more fertile than those belonging to women. The infertility of land poses a significant challenge as it can impede crop production and reduce productivity. Stolarski et al. (2015) also highlighted that high soil fertility is instrumental in achieving sustainable high-yield crop production. Key informants pointed out that the primary reason for the lower fertility of women's chickpea plots compared to their male counterparts is attributed to the limited soil conservation and crop management skills among women, along with the lack of crop rotation practices, especially considering the relatively small size of land held by women.

Training on newly released chickpea varieties

One of the key strategies to narrow the gender yield gap in agriculture is by offering effective training and support to female farmers (Quisumbing and Meinzen 2001). The survey findings revealed that only 25% of women compared to 48% of men had attended training on chickpea technology management, indicating that 23% more women had missed out on such training opportunities. Insights from Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) shed light on the reasons behind the lower attendance of women in these training sessions, attributing it to the biased selection of farmers for training by development workers and the inconvenient timing and locations of the training sessions.

Several women and model farmers who did participate in the training noted that the scheduling of the sessions was often unsuitable for them. Many women, being the sole individuals responsible for both household and agricultural duties, found it challenging to attend training sessions located far from their homes. This lack of access to updated agricultural technologies hampers women farmers' productivity, leading to lower yields compared to their male counterparts. Colverson (2013) also emphasized agricultural training has big impact in challenging gender norms and stereotypes that hinder women's engagement in agriculture.

Effect of religious/cultural taboos on women and men farmers productivity

Religious and cultural taboos have a significant impact on the productivity of women and men farmers, often aggravated by their lower levels of education, which lead them to unquestioningly accept these norms. The adverse effects of these taboos on both genders were highlighted during Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs). A participant in the FGD expressed the challenges faced by women, stating, "We are excluded from farm management roles and confined to our homes. Our sufferings are a result of cultural norms that confine us and limit our exposure to the outside world." They further emphasized that structural arrangements within their communities, shaped by cultural norms and religious teachings, hinder their equal participation in various development activities alongside men.

Moreover, male farmers also shared their experiences regarding a specific cultural taboo known as "Warra Guma," which prohibits them from engaging in agricultural activities. "Warra Guma" in Afaan Oromo signifies familial ties to individuals involved in a deadly conflict with another family, leading to exclusion from shared trainings and cooperative memberships with the family of the late person. In general, these religious and cultural taboos impact the production and productivity of both women and men farmers in the study area, with women bearing a heavier burden. Colverson (2013) also emphasized that challenging society's norms and advocating gender equality can empower women to take on leadership roles within their communities and in agricultural value chains.

Conclusion and recommendation

In Ada'a woreda, it was observed that women farmers yielded 29% less chickpea per hectare compared to their male counterparts. Several significant factors were identified as constraints to the productivity of women farmers, including land size, availability of labor, chickpea variety (improved or local), soil fertility, membership in seed producer cooperatives, and access to extension services. Gender-specific factors such as unequal treatment, restricted mobility, excessive workload, and religious/cultural taboos also played a role in limiting the productivity of women farmers.

Drawing from these findings, the following recommendations are proposed: development initiatives should be tailored to the diverse needs of different farmer groups, ensuring inclusivity in terms of timing and location. Agricultural extension services must be equitably provided to all farmers, with a focus on encouraging women to join seed producer cooperatives and emphasizing the benefits of land allocation for continuous field monitoring and the cultivation of improved crop varieties. Efforts should be made to raise awareness about the impact of social constructs that hinder women's mobility, decision-making power, and perpetuate the perception of women as inherently weaker. Furthermore, there is a need to educate society about the gender-based constraints that impede

female farmers' productivity and, consequently, hinder the country's overall development.

Recognizing the limitations of this study, it is important to acknowledge that the research was confined to a specific area in the Oromia region and focused on the gender yield gap analysis of chickpea production. Future studies should encompass a broader spectrum, examining gender dynamics and yield gaps across all regions of the country. Additionally, further research is needed to explore the contributions of women who are wife as household productivity drivers and to delve into the impact of socially constructed norms on women's participation in development initiatives.

Acknowledgements
The authors are grateful to the Ethiopian Institute of Agricultural Research (EIAR) for the financial support, and Addis Ababa University. We are thankful to Debrezeit Agricultural Research Center for assisting this work. We also thank the host farmers, district, and kebele agricultural experts for their contributions in site selection, field management, and cooperation. Criteria for authorship are; the first author was student in Addis Ababa University, Ethiopia, and the second and third authors were advisers.

Author contributions
All authors are contributed equally from the conception and design of the study.

Funding
The manuscript is funded by Ethiopian institute of agricultural research and Addis Ababa University, Ethiopia.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Competing interests
The authors declare that the manuscript is original and has not been published elsewhere, and there is no conflict of interest. Signed competing interests of all authors will be submitted after the acceptance of the manuscript.

Received: 13 November 2023 Accepted: 8 August 2024
Published online: 04 October 2024

References

African Development Bank Group. Empowering African women: an agenda for action. The Africa Gender Equality Index. 2015;2015:1–30.
Belsley DA. Conditioning diagnostics: collinearity and weak data in regression. New York: Wiley; 1990.
Central Statistical Analysis (CSA). Centeral Statistical Agency. Addis Ababa, Ethiopia, 2005.
Colverson. Closing the gender gap in agriculture: a trainer's manual. ILRI Manual 9. Nairobi, Kenya: ILRI; 2013.
Danso-Abbeam G, Ehiakpor DS, Aidoo R. Agricultural extension and its effects on farm productivity and income: insight from Northern Ghana. Agric Food Secur. 2018;7(1):1–10. https://doi.org/10.1186/s40066-018-0225-x.
Doss. Collecting sex-disaggegated data. Presented by Cheryl Doss (PIM/IFPRI/University of Oxford), as part of the Annual Gender Capacity Development Workshop hosted by the CGIAR Collaborative Platform for Gender Research, Addis Ababa, 27–28 September 2018. Washington DC: International Food Policy Research Institute; 2018.
Duffy M. Economies of size in production agriculture. J Hunger Environ Nutr. 2009;4(3–4):375–92. https://doi.org/10.1080/19320240903321292.
FAO (2014) Food and Agriculture Organization (FAO). The state of food and agriculture 2014: Innovationin family farming. Retrieved from http://www.fao.org/3/a-i4040e
Fikre A. An overview of chickpea improvement research program in Ethiopia. J Int Legume Soc. 2014;3(June 2014):47–9.
Gebre GG, Isoda H, Rahut DB, Amekawa Y, Nomura H. Gender differences in agricultural productivity: evidence from maize farm households in southern Ethiopia. GeoJournal. 2021;86(2):843–64. https://doi.org/10.1007/s10708-019-10098-y.
Girma (2010) Chickpea and Lentil Research in Ethiopia. Annual Center Review, DzARC, EIAR, Bishoftu, Ethiopia. 1–10p.
Kassam A, Friedrich T, Derpsch R. Global spread of conservation agriculture. Int J Environ Stud. 2018;76(1):29–51. https://doi.org/10.1080/00207233.2018.1494927.
Kotu B, Admassie A. Potential impact of improved varieties on poverty reduction: a case study of selected cereal crops in two districts of Ethiopia, No 212013, 2015 Conference, August 9-14, 2015, Milan, Italy, International Association of Agricultural Economists.
Mugisha J, Sebatta C, Mausch K, Ahikiriza E, Kalule Okello D, Njuguna EM. Bridging the gap: decomposing sources of gender yield gaps in Uganda groundnut production. Gend Technol Dev. 2019;23(1):19–35. https://doi.org/10.1080/09718524.2019.1621597.
Mulema AA, Damtew E. Gender-based constraints and opportunities to agricultural intensification in Ethiopia: asystematic review. ILRI Project Report. Nairobi, Kenya: ILRI 2016. https://hdl.handle.net/10568/78212
Naing NN. Determination of sample size. Malays J Med Sci. 2003;10(2):84–6.
Pender J, Gebremedhin B. Land management, crop production, and household income in the highlands of Tigray, Northern Ethiopia: an econometric analysis. In: Pender J, Place F, Ehui S, editors. Strategies for sustainable land management in the East African Highlands. Washington DC: International Food Policy Research Institute; 2006.
Peterman A. Women's property rights and gendered policies: implications for women's long-term welfare in rural Tanzania. J Dev Stud. 2011;47(1):1–30. https://doi.org/10.1080/00220381003600366.
Quisumbing AR, Meinzen RS. Empowering women to achieve food security. IFPRI 2020 Vision Brief 6. Washington, DC: International Food Policy Research Institute; 2001.
Srinivasan P, Mukherjee A. Determining the optimal size of focus groups in qualitative market research: a literature review. J Qual Mark Res. 2019;19(1):66–81.
Stolarski MJ, Krzyżaniak M, Szczukowski S, Tworkowski J, Załuski D, Bieniek A, Gołaszewski J. Effect of increased soil fertility on the yield and energy value of short-rotation woody crops. Bioenergy Res. 2015;8(3):1136–47. https://doi.org/10.1007/s12155-014-9567-9.
Tesfaye. Addressing gender inequality in Ethiopian agriculture: challenges and opportunities. Discussion Paper, International Food Policy Research Institute; 2020.
Tiruneh A, Tesfaye T, Mwangi W, Verkuijl H. Gender differentials in agricultural production and decision-making among smallholders in Ada, Lume, and Gimbichu Woredas of the Central Highlands of Ethiopia. In: Mexico, D.F.: International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO). Abstract: (Issue February). 2001. http://apps.cimmyt.org/research/economics/map/impact_studies/impstudea_list/CentralHEth.pdf

Publisher's Note