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RECEIVED 31 January 2023

ACCEPTED 12 September 2023

PUBLISHED 02 October 2023

CITATION

Liani ML, Cole SM, Mwakanyamale DF,
Baumung L, Saleh N, Webber A, Tufan HA and
Kapinga R (2023) Uneven ground?
Intersectional gender inequalities in the
commercialized cassava seed system in
Tanzania.
Front. Sustain. Food Syst. 7:1155769.
doi: 10.3389/fsufs.2023.1155769

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Uneven ground? Intersectional gender inequalities in the commercialized cassava seed system in Tanzania

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Cassava (*Manihot esculenta* Crantz) is an important crop in Africa, especially to women who rely on it as a household staple food and source of income. In Tanzania, a recent move toward commercializing the cassava seed system resulted in significantly fewer women than men farmers, known as Cassava Seed Entrepreneurs (CSEs), producing improved seed for sale to fellow farmers. To document the barriers and constraints that create gender inequalities in the seed system to better understand women's low representation and experiences in commercialized cassava seed production, we carried out a mixed-methods study in the Southern, Eastern, and Lake Zones of Tanzania in 2021. The quantitative analysis found differences in key individual and household characteristics between CSEs and farmers who aspired to be but did not participate as CSEs (or A-CSEs) as well as between women CSEs and women A-CSEs. After running a logistic regression, results indicated that sex of the farmer (being male) was a statistically significant predictor of participating as a CSE ($p < 0.05$), along with having a secondary education ($p < 0.05$) and owning a bank account ($p < 0.01$). The qualitative analysis highlighted challenges women CSEs face. They spoke about having lower access to and control over prerequisite resources, which are shaped by other intersecting social identities such as marital status and age. Gender stereotypes about their capacities to manage their seed businesses can demotivate them from carrying out their work as well as experiences dealing with discriminatory gender norms that limit their travel to attend trainings outside their communities. Despite these barriers, some women CSEs expressed positive outcomes that have accrued from their participation in commercialized seed production, including enhanced social status and improved living standards. For the commercialized cassava seed system to be more socially inclusive and sustainable, we argue that there is need to adopt gender-aware approaches to address the underlying barriers and biases that exclude women and other social groups. Development efforts should consider combining social change innovations with seed system interventions to address the inequitable norms and power relations that create unique constraints for women to operate effectively as seed entrepreneurs.

KEYWORDS

cassava, entrepreneurship, gender, intersectionality, mixed methods, seed systems

1. Introduction

Cassava (*Manihot esculenta* Crantz) is widely grown across sub-Saharan Africa (SSA) and considered the second most important staple food crop on the continent after maize (Sonnewald et al., 2020). It is mainly produced, processed, and traded in West, Central, and East Africa, including in Tanzania (Andersson et al., 2016; Masamha et al., 2018; Reincke et al., 2018). Within SSA, cassava is often referred to as a “woman’s crop” (see Nweke, 2001 for a detailed discussion) – a label that is derived from numerous factors including the low market value of cassava as an established staple food mainly grown and consumed at home, along with characteristics such as its low input requirements and drought tolerance (Forsythe et al., 2016; Teeken et al., 2018). Consequently, it is considered as a crop that can be produced by groups with limited resources such as smallholder women farmers and sold and/or consumed to increase incomes and/or contribute to household food security (Masamha et al., 2018). Scholars have argued, however, that the more commercialized cassava becomes, the more interest men take in its production and marketing (Nweke, 2004). This decline in women’s control with increasing commercialization (Fischer and Qaim, 2012) is a common occurrence in other agricultural value chains in SSA (Coles and Mitchell, 2011; Njuki and Sanginga, 2013; Forsythe et al., 2016).

Cassava is considered an “emerging market” commodity in Tanzania (Bennett et al., 2012; see also Reincke et al., 2018). The major cassava producing areas are Southern, Eastern, Western and Lake Zones, which together produce about 80% of the total cassava produced in the country (Ministry of Agriculture, 2020). Current estimates show that cassava production supports around 40% of rural farmers, majority of whom are resource-poor (Mtunguja et al., 2019), and thus it has the potential to contribute to tackling unemployment and food security. However, cassava suffers from low farm productivity in Tanzania due in part because of the use of local varieties that are highly susceptible to Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD; Legg et al., 2022). Productivity can be enhanced if farmers adopt improved cassava varieties that are high yielding and tolerant to CMD and CBSD and utilize good agronomic practices (Mtunguja et al., 2019; Legg et al., 2022).

The Government of Tanzania has emphasized the need to work toward increasing overall production in the country to meet the growing demand for cassava through the development of a 10-year (2020-2030) National Cassava Development Strategy (Ministry of Agriculture, 2020). The strategy aims to create a commercialized cassava sub-sector for food security and income generation by promoting improved technologies across the value chain and increasing cassava productivity, profitability, and employment opportunities in the sub-sector. Through partnerships with non-governmental organizations and the private sector, the Government of Tanzania has begun to set up a commercially sustainable cassava seed system. One well-known initiative is the establishment of networks of cassava seed entrepreneurs (CSEs). CSEs consist of smallholder farmers who produce, promote, and enhance access to planting material (stem cuttings) of improved high-yielding and disease-tolerant varieties to nearby cassava farmers as a means of generating additional income (Legg et al., 2022).

Our study was nested in one such initiative titled “Building an Economically Sustainable Seed System in Tanzania for Cassava” project¹ (henceforth BEST Cassava project). The project catalyzed demand-driven private sector models and public-private partnerships to strengthen commercialization of the cassava seed supply chain by delivering officially released cassava varieties for farmers via a network of government-certified commercial CSEs. The CSEs produced basic, certified, and quality declared seed in the primary cassava growing regions of Tanzania. The CSEs were selected from communities within these regions through village information meetings using a set of criteria. Because gendered recruitment targets were not intentionally set, the project’s CSE recruitment inadvertently tended to favor men. Three years into project implementation, women comprised only 24% of the CSEs recruited and trained by the project despite their considerable involvement in the cassava value chain in Tanzania. For example, while men tend to be more involved in clearing and tilling the land for cassava production, women are active in preparing stem cuttings, planting, weeding, and managing pests and diseases, processing cassava, and preparing cassava-based foods (Masamha et al., 2018).

At its mid-point, the BEST Cassava project recognized the disparity between the importance of cassava to women and their abilities to potentially profit from it at the highest levels of the seed system. As a result, this study was commissioned to formally document some of the barriers and constraints that create gender inequalities in the cassava seed system to better understand women’s low representation and experiences in commercialized cassava seed production.

2. Materials and methods

2.1. Study design

Our study was carried out in February and March of 2021 in the Southern, Eastern and Lake Zones of Tanzania covering 11 cassava growing regions, including Mtwara, Lindi, Ruvuma, Morogoro, Coast, Tanga, Mwanza, Mara, Geita, Kagera, and Kigoma. The study targeted two main groups during interviews: women and men farmers who were operating as CSEs in the project regions producing commercial or quality declared cassava seed for sale in their locales; and women and men farmers who were referred by the District Council for consideration as CSEs but who were not selected by the BEST Cassava project because they did not ultimately meet all the criteria used by the project to inform their selection of CSEs. In this paper, we refer to farmers who were not selected using the criteria as “aspiring” CSEs (A-CSEs). The selection criteria used by the project included having: (1) the financial resources required to establish and manage a seed multiplication field; (2) business aptitude and mindset; (3) access to appropriate land with isolation distances from other nearby cassava fields; (4) reasonable proximity to well-trafficked roads; (5) willingness to attend training prior to starting seed production; and (6) willingness and aptitude to abide by cassava seed agronomy requirements. More details on the selection criteria used by the project are presented in Table 1.

¹ See <https://www.meda.org/projects/best-cassava/#:~:text=Name,smallholder%20farmers%20and%20their%20households>.

The study also interviewed Zonal Managers and Area Field Facilitators (collectively referred to hereafter as AFFs) employed by the project to recruit, train, and support CSEs.

2.2. Data collection methods

We adopted a cross-sectional study design and employed a mixed-methods approach to data collection. First, quantitative data were gathered using a survey tool in open data kit (ODK), which was administered to CSEs and A-CSEs to better understand potential gendered barriers and constraints to their recruitment. Quantitative data were uploaded on to a server via an internet connection each evening as the research team returned from fieldwork. After collecting the quantitative data, we conducted in-depth interviews (IDIs) with a small group of purposively selected CSEs, who had participated in the survey, to gather more detailed information about their perspectives and experiences operating as cassava seed producers. We also conducted key informant interviews (KIIs) with AFFs to triangulate information

from the IDIs as well as to gather insights about their experiences of working with and supporting CSEs. The qualitative interviews were audio-recorded using a digital voice recorder, alongside note taking.

All interviews were carried out in *Kiswahili*, the language most widely spoken in Tanzania. On average, the qualitative interviews lasted 30 to 45 min and the quantitative interviews lasted 90 min.

2.3. Sampling

A proportionate stratified random sampling strategy was used to draw a sample of 298 farmers (218 CSEs and 80 A-CSEs) for the quantitative component of our study from a total population size of 465 CSEs and 120 A-CSEs based on 95% confidence level and 5% margin of error. We stratified the populations according to the project zone of operation (Southern, Eastern, or Lake Zone) and the total numbers of women and men CSEs and A-CSEs in each zone. [Figure 1](#) shows the sample distribution of the CSEs and A-CSEs interviewed in each zone. Of the 218 CSEs interviewed, 169 (78%) were male and 49 (22%) were female, while for the 80 A-CSEs interviewed, 50 (62%) were male and 30 (38%) were female.

Thirty CSEs (21 men and nine women) were selected to participate in the IDIs. Based on our operational age categorization for which we disaggregated the CSEs as younger (< 35 years old) and older (\geq 35 years old), 15 CSEs (50%) were categorized as older male CSEs and 7 (23%) as older female CSEs. Six CSEs (20%) were categorized as younger male CSEs and the remaining 2 CSEs (7%) as younger female CSEs ([Figure 2](#)). Of the 30 CSEs, 19 (63%) were categorized as being “successful” based on their abilities to set up their cassava seed production businesses, generate income from their seed sales, and expand their seed production. The remaining 11 CSEs (37%) were categorized as being “not-so-successful” by AFFs as they were facing challenges to setting up and operating their cassava seed production businesses. These CSEs were identified by AFFs based on their experiences during the project. These figures were also disaggregated by sex of the CSE (see [Figure 2](#)). Finally, 11 CSEs who participated in the IDIs were from the Lake Zone, 11 from the Southern Zone, and eight from the Eastern Zone.

Thirteen AFFs (11 men and two women) participated in the KIIs. The 13 AFFs comprised all field staff employed by the project to recruit, train, and support CSEs across the three zones.

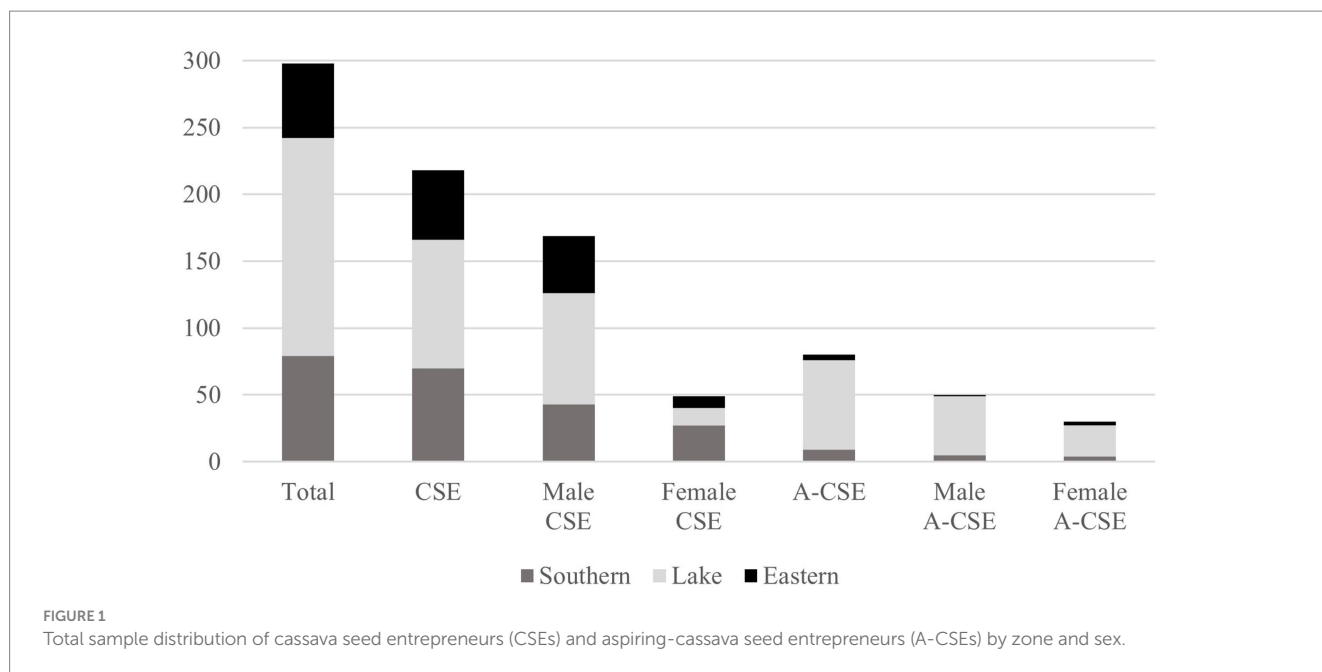
2.4. Data analysis

After quantitative data cleaning, eight observations from the sample [5 CSEs (three men and two women) and three A-CSEs (all men)] were excluded because of missing data (four observations) and outliers (four observations) on the variable representing total household land size, which brought the sample size down to 290 (213 CSEs and 77 A-CSEs) for data analysis. The quantitative data were analyzed using Stata 16.0 (Stata Corp, College Station, TX, United States). We examined differences in key individual and household characteristics between women and men CSEs and A-CSEs. The variables representing these characteristics were included in our analysis because they were believed to be important in determining whether cassava farmers were selected to be CSEs per the selection criteria and other related factors. The individual-level variables that were examined included age, marital and

TABLE 1 Selection criteria for cassava seed entrepreneurs (CSEs).

| Selection criterion | Description |
|---|--|
| Financial resources | Access to financial resources required to establish and manage the seed multiplication field. On average, a CSE needs Tsh 500,000–600,000 (approximately USD 250–300) for one acre of cassava seed multiplication. |
| Business acumen and record keeping capacity | Business aptitude and mindset with a desire to create a sustainable seed business and commitment to record keeping of the cassava seed business. Business aptitude and mindset assessed by determining: (i) an individual's background and experience in business-related roles; (ii) commitment to conducting business and being innovative with adaptability and resilience to handle change and uncertainty. Farmers with such qualities were identified in consultation with extension officers and village leaders. |
| Availability of land | Access to appropriate land with isolation distances* from other nearby cassava fields as per the Tanzania Official Seed Certification Institute (TOSCI) requirements |
| Proximity of land to roads | Reasonable proximity to well-trafficked roads for marketing and demonstration plots |
| Training interest | Willingness to attend training prior to starting seed production |
| Farming acumen | Willingness and aptitude to abide to cassava seed agronomy requirements |

*Isolation distance is recommended for prevention of virus infections in cassava crops.



educational status, whether the respondent borrowed money in the past 12 months and whether they own a bank account. The household-level variables included household wealth status (low, medium, or high)², household size (total number of members), and total household land size (in acres). Mean differences were assessed using a *t* test and median differences were assessed using a Wilcoxon rank-sum test to determine if differences were significant at or below the 5% confidence level.

We also ran a logistic regression to identify which individual and household characteristics increased the likelihood of participating (or being selected) as a CSE. We conducted several diagnostic tests on the logistic regression model. These included a goodness-of-fit test and tests for specification error and multicollinearity. We also carried out a receiver operating characteristic (ROC) analysis to determine the tradeoff between the sensitivity of the positive cases (those who participated as CSEs) and the specificity of the negative cases (those who did not participate as CSEs) and whether it is acceptable. The diagnostic tests indicated that the model fit the data well ($\chi^2=2.73$, $p=0.95$) and was correctly specified ($z=-1.17$, $p=0.24$). The test for multicollinearity indicated that the independent variables are not linear combinations of each other as all VIF values were below 10. The

value of the area under the ROC curve for the model was 0.75, indicating that the tradeoff of sensitivity and specificity was acceptable.

For qualitative data, audio interviews were translated and transcribed from *Kiswahili* into English by experienced qualitative research assistants. The transcripts were verified by comparing the audio files and scripts with the field notes. Thereafter, the data were manually coded and organized in a table. Analysis entailed extracting emergent themes from the transcribed interviews guided by a gendered agri-food systems framework and utilizing an intersectional lens.

2.5. Analytical framework

Our analytical approach was informed by a gendered agri-food systems (AFS) framework espoused by Njuki et al. (2022a). According to the framework, three key components comprise the AFS: (i) value chains from production through marketing; (ii) food environment; and (iii) consumer behavior. The components are influenced and anchored by five AFS drivers, all of which are embedded in a gendered system with structural inequalities and shaped by gendered shocks and vulnerabilities. AFS components are mediated by four interrelated dimensions of gender (in)equality. These include: (i) women's agency; (ii) gendered social norms; (iii) access to and control over resources; and (iv) policies and governance. The four domains operate along two main axes of gender (in)equality, which highlights the interrelationship between the formal and informal levels and the individual and systemic levels. Taken together, AFS components and the four interrelated dimensions create different development outcomes for women and men.

Our analytical approach focuses on some of the framework's four interrelated dimensions of gender (in)equality. This four-dimensional space provides a lens for analyzing the barriers and constraints that create gender inequalities in the cassava seed system and to help better understand women's low representation and experiences in commercialized cassava seed production.

² To determine household wealth status, we developed wealth quintiles using principal component analysis (PCA) using the following 20 asset variables: manual uprooter, machete, pesticide spray machine, ridger, motorized weeder, diesel pump, treadle pump, watering can, mobile phone, shade tent, speaker (for marketing), bicycle, motorcycle, vehicle, radio, cooking pot, hand mixer, refrigerator, television, and sofa (couch). After running the PCA, the first component was chosen to use as the wealth variable as it accounted for the largest proportion of the variance (eigenvalue=3.2; % of the variance=16.2). The wealth variable was then ranked into tertiles, dividing respondents into roughly 3 equal groups. Finally, the wealth variable was used to create three binary variables representing the low, medium, and high tertile groups.

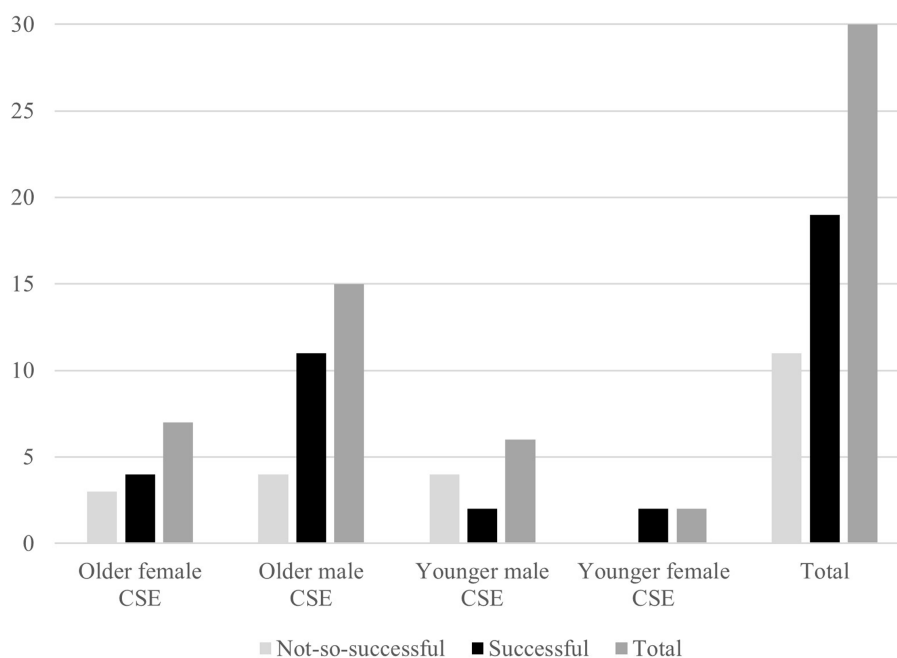


FIGURE 2
Classification of in-depth interviews with CSEs, by sex, age category, and CSE status.

According to [Kabeer \(2005\)](#), while “agency” focuses on individual consciousness and capability to define one’s goal and make informed choices and decisions, it is through one’s “access to and control over resources” – which are distributed through institutions and relationships in a society – that serves as a medium for exercising agency. In most rural households in Africa, power dynamics are usually skewed in favor of men thus constraining women’s abilities to make informed decisions ([Coles and Mitchell, 2011](#)). [Akram-Lodhi and Komba \(2018\)](#) have observed that in many communities within Tanzania, women are primarily dependent on spousal support to access resources such as land, thus limiting their abilities to make strategic decisions on the choice of crops to cultivate. In the same context, [Masamha et al. \(2018\)](#) have noted that sometimes married women can only get access to land ownership rights through their husbands if they are widowed. In instances where women control land, it is often of poor quality ([Sikira and Kashaigili, 2016](#)). Nonetheless, despite women’s contribution to performing activities across the commercialized cassava value chain, men tend to control the use of productive resources such as land as well as decision making on use of income accrued from sales of cassava products ([Masamha et al., 2017, 2018](#)).

Women’s access to resources and opportunities shapes their agency and is mediated by “gendered social norms” – discriminatory traditions and exclusionary practices – that are embedded in the informal systems and deep structures of power in the society that determine the way institutions operate, often in invisible ways that (re) produce gender inequalities ([Kabeer, 2005; Njuki et al., 2022a,b](#)). In Tanzania, women’s abilities to participate in farm production is often shaped by informal conditional rules mediated by men ([Akram-Lodhi and Komba, 2018](#)), which serve as barriers restricting, for example, women’s freedom of movement to market cassava products ([Masamha et al., 2018](#)), among other things (see [Langevang et al., 2018](#)).

Lastly, “policies and governance” denotes a system of formal institutional arrangement characterized by set laws, rules and regulations. Such systems usually serve formal arenas where power is legitimately exercised, reinforcing institutional bias and cultural or ideological norms that subjugate subordinate groups, and thus constraining people’s abilities to make strategic life choices ([Kabeer, 2005](#)). Given that institutions and policies that promote gender equality and women’s empowerment in AFS are generally lacking in low-income countries ([Meinzen-Dick et al., 2013](#)), changes to the existing policies and governance systems are needed to positively influence opportunities for women’s and men’s participation and benefits in AFS ([Njuki et al., 2022a](#)).

We also acknowledge that socially inclusive commercialized seed systems require the enabling environment for those facing marginalization to engage meaningfully in their businesses. This involves transformative change, which requires considering how power relations and social norms interact with critical intersections of multiple social identities such as gender, race and class to privilege certain actors and marginalize others ([Hillenbrand et al., 2015](#)). It is thus important to recognize heterogeneity among women and men. To do this, we use an intersectional lens (see [Crenshaw, 1991; Hancock, 2007; Hankivsky, 2014](#)). Intersectionality considers how gender intersects with multiple social identities to shape women’s and men’s experiences of discrimination and oppression. Such social identities can include, for example, age, marital and educational status, occupation, geographical location, ethnicity, among many others.

2.6. Ethical considerations

The Internal Review Board (IRB) of the International Institute of Tropical Agriculture (IITA) approved the research on January 28,

2021. All study participants were debriefed and asked to sign informed consent forms prior to participating in the interviews. In protecting participant's anonymity and confidentiality, all identifiers were replaced with pseudonyms. All illustrative quotes were carefully reviewed for their potential to reveal individual identities.

3. Results

In this section, we present the descriptive statistics of the individual and household characteristics of the CSE and A-CSE study participants. Thereafter, we present the findings from the logistic regression analysis that was employed to determine which individual and household characteristics increase the likelihood of participating as a CSE. The quantitative results are followed by qualitative findings on the key drivers of intersectional gender inequalities in commercialized cassava seed production. These findings are structured around inequalities in access to and control over productive resources and the influence of gendered social norms and stereotypes shaping women's experiences as CSEs. We also present findings on the positive outcomes associated with women's engagement in CSE work.

3.1. Quantitative results

Table 2 presents the descriptive statistics of the individual and household characteristics based on the sex of the respondent and their CSE status. Overall, the sample of CSEs and A-CSEs can be classified as being middle age. No statistically significant median age differences were found within the different groups. A larger percentage of men compared to women CSEs and A-CSEs were married. For CSEs, 96% men vs. 66% women were married ($p < 0.01$), and for A-CSEs, 94% men vs. 77% women ($p = 0.03$) were married. Unsurprisingly, no statistically significant differences were found concerning the educational and wealth status between women and men CSEs and between women and men A-CSEs. A greater percentage of women A-CSEs (37%) borrowed money over the past 12 months compared to men A-CSEs at 13% ($p < 0.01$). No statistically significant within group differences were found between women and men concerning their bank account ownership status, although a much greater percentage of CSEs compared to A-CSEs indicated that they owned a bank account (77% vs. 45%, respectively, $p < 0.01$; *value of p* not provided in the table). Median household size for men CSEs was higher than for women CSEs (77% vs. 45%, respectively, $p < 0.01$), but no statistically significant difference was found between women and men A-CSEs. Finally, clear gender differences were found between median total household land size (in acres) held by women and men CSEs (7 acres vs. 10 acres, respectively, $p < 0.01$) and between women and men A-CSEs (4.5 acres vs. 8 acres, respectively, $p < 0.01$).

Table 3 presents these same individual and household characteristics but for women CSEs and A-CSEs only. A larger percentage of women CSEs were classified as having a higher wealth status than women A-CSEs (36% vs. 13%, respectively, $p = 0.03$), had greater access to financial services (bank account; 77% vs. 40%, respectively, $p < 0.01$), and had larger median household land sizes (7 vs. 4.5 acres, respectively, $p = 0.04$). A larger percentage of women A-CSEs, on the other hand, were classified as having low or no formal

education compared to women CSEs (13% vs. 0%, respectively, $p < 0.01$).

After including the individual and household characteristics in the logistic regression model, we found that the sex of the farmer (being male) was a statistically significant predictor of participating as a CSE ($p < 0.05$), along with having a secondary education ($p < 0.05$) and owning a bank account ($p < 0.01$; Table 4).

3.2. Qualitative results

3.2.1. Inequalities in access to and control over productive resources

Cassava farmers were required to have access to appropriate land sizes for cultivation and be able to ensure minimum isolation distances³ between their own cassava fields and those of nearby farmers to be selected as a CSE. They also needed to show that they had access to financial resources [an average of Tsh 500,000–600,000 per acre (approximately USD 250–300)] that would enable them to establish and manage their seed multiplication fields by purchasing inputs, farming equipment, and hiring casual labor.

The qualitative data highlighted several challenges women face as they operated their cassava seed production businesses. Women CSEs spoke about having lower access to and control over land and financial resources (capital), which was shaped by other intersecting social identities such as marital status, age, and positional hierarchy in the family.

Unequal access to and control over land: We established from the qualitative data that owning fertile land was considered by both women and men study participants as characteristic of being a successful CSE. However, most women and young men experienced differential challenges with accessing appropriate land for CSE work, shaped by other intersecting axes of inequalities. For example, an older woman CSE asserted that single (unmarried) women experience many difficulties to succeed as CSEs as they are only likely to own few acres of land thus unable to meet the minimum required land size for CSE work. Nonetheless, for those women who owned land, most of them tended to have small pieces of scattered land, which disqualified them from becoming CSEs. Such insights were corroborated by key informants as exemplified by the following excerpt:

“There are some constraints for women, where some really do want to become CSEs but do not have enough land...the parameters state that one should have at least four acres in order to be registered as a CSE. So sometimes, most women have less acres than that, which are scattered. So the four acres at one area is usually a challenge... so many get stuck there” (KII #09, male AFF, Lake Zone).

³ In line with the Tanzania Official Seed Certification Institute (TOSCI) requirements, isolation distance in the BEST Cassava project varied depending on the level of certification sought. For pre-basic seed production, the minimum isolation distance was 300 meters; for basic, 200 meters; for certified or commercial, 100 meters; and for quality declared seed, 50 meters.

TABLE 2 Key descriptive statistics, by sex and CSE status, see notes.

| | CSE (n = 213) | Male (n = 166) | Female (n = 47) | Value of <i>p</i> * | A-CSE (n = 77) | Male (n = 47) | Female (n = 30) | Value of <i>p</i> * |
|--|------------------|-------------------|--------------------|------------------------|-------------------|------------------|--------------------|------------------------|
| Age (years) | 48 (40, 58) | 49 (42, 59) | 46 (37, 56) | 0.16 | 46 (40, 52) | 46 (42, 53) | 47 (38, 52) | 0.51 |
| < 35 years old (1 = yes) | 0.10 | 0.10 | 0.11 | 0.84 | 0.10 | 0.11 | 0.10 | 0.93 |
| Married (1 = yes) | 0.90 | 0.96 | 0.66 | 0.00 | 0.87 | 0.94 | 0.77 | 0.03 |
| Borrowed money past 12 months (1 = yes) | 0.32 | 0.33 | 0.32 | 0.94 | 0.22 | 0.13 | 0.37 | 0.01 |
| Own a bank account (1 = yes) | 0.77 | 0.77 | 0.77 | 0.94 | 0.45 | 0.49 | 0.40 | 0.45 |
| Educational status (1 = yes) | | | | | | | | |
| Low/no education | 0.03 | 0.04 | 0.00 | 0.19 | 0.09 | 0.06 | 0.13 | 0.31 |
| Primary | 0.63 | 0.63 | 0.62 | 0.85 | 0.64 | 0.60 | 0.70 | 0.36 |
| Secondary | 0.23 | 0.23 | 0.23 | 0.99 | 0.16 | 0.21 | 0.07 | 0.09 |
| Post secondary | 0.12 | 0.11 | 0.15 | 0.53 | 0.16 | 0.19 | 0.10 | 0.29 |
| Household wealth status (1 = yes) | | | | | | | | |
| Low | 0.30 | 0.28 | 0.38 | 0.16 | 0.47 | 0.47 | 0.47 | 0.99 |
| Medium | 0.35 | 0.37 | 0.26 | 0.13 | 0.29 | 0.21 | 0.40 | 0.08 |
| High | 0.35 | 0.35 | 0.36 | 0.88 | 0.25 | 0.32 | 0.13 | 0.07 |
| Household size (number) | 6 (5, 8) | 7 (5, 9) | 5 (4, 6) | 0.00 | 6 (5, 8) | 6 (5, 10) | 6 (5, 8) | 0.23 |
| Household land size (total in acres) | 10 (6, 17) | 10 (6, 20) | 7 (4, 12) | 0.00 | 6 (3.5, 10) | 8 (4, 15) | 4.5 (3, 8) | 0.01 |

Values for the continuous variables are provided as the median (25th,75th percentiles in parentheses). Values for the binary variables are provided as means. *Values obtained either by Wilcoxon rank-sum or *t* tests, where appropriate. CSE, cassava seed entrepreneur; A-CSE, aspiring-CSE (i.e., cassava farmers who were not selected to be CSEs).

Concerns about women's impediments to access and own land were reinforced by prevailing discriminatory social norms that favor men. In the same vein, a male study participant argued that:

"If married women own land they can chase you anytime" (IDI #28, younger male CSE, Successful, Eastern Zone).

Another male participant from the same region spoke out that:

"In our tribe [Zigua] it is nearly impossible for women to own land...women need to be guided always, so a man should own land and can just help the wife. If a woman is unmarried, she can go and farm on her relative's farm" (IDI #29, older male CSE, Not-so-successful, Eastern Zone).

Such insights were affirmed by key informants who indicated that based on their normative positional hierarchy in the family, men are traditionally the main custodians of land in rural Tanzania. Thus, married women tend to have less input concerning which part of their household's land holdings to use for a given purpose. Furthermore,

women's lack of ownership of land may help create the conditions for male capture of CSE opportunities and discourage women from pursuing CSE work as exemplified in the following quotes:

"In this area, women are not involved in owning resources such as land and other assets. If they are married, she is not entitled to getting the share of resources from either parents or husbands. The husbands are the ones who own all the resources" (KII #12, female AFF, Lake Zone).

"Land is owned by men in the family. In this case, when we recruit CSEs, the woman will automatically leave the opportunity to her husband to attend the meetings that we organize to sensitize farmers. The husband will listen to us and if he wishes, he may allow his wife to be the CSE, or else, he will seize the opportunity" (KII #07, male AFF, Eastern Zone).

They further emphasized that without involvement of their spouses, married women face difficulties becoming successful CSEs. Indeed, some key informants also observed that where women do not own land, some may opt to rent land to enable them to start up their

TABLE 3 Key descriptive statistics of women CSEs and A-CSEs, see notes.

| | CSE (n = 47) | A-CSE (n = 30) | Value of p* |
|---|-----------------|-------------------|-------------|
| Age (years) | 46 (37, 56) | 47 (38, 52) | 0.71 |
| < 35 years old | 0.11 | 0.10 | 0.93 |
| Married (1 = yes) | 0.66 | 0.77 | 0.32 |
| Borrowed money past 12 months (1 = yes) | 0.32 | 0.37 | 0.67 |
| Own a bank account (1 = yes) | 0.77 | 0.40 | 0.00 |
| Educational status (1 = yes) | | | |
| Low/no education | 0.00 | 0.13 | 0.01 |
| Primary | 0.62 | 0.70 | 0.46 |
| Secondary | 0.23 | 0.07 | 0.06 |
| Post secondary | 0.15 | 0.10 | 0.54 |
| Household wealth status (1 = yes) | | | |
| Low | 0.38 | 0.47 | 0.47 |
| Medium | 0.26 | 0.40 | 0.19 |
| High | 0.36 | 0.13 | 0.03 |
| Household size (number) | 5 (4, 6) | 6 (5, 8) | 0.04 |
| Household land size (total in acres) | 7 (4, 12) | 4.5 (3, 8) | 0.04 |

Values for the continuous variables are provided as the median (25th,75th percentiles in parentheses). Values for the binary variables are provided as means. *Values obtained either by Wilcoxon rank-sum or t tests, where appropriate. CSE, cassava seed entrepreneur; A-CSE, aspiring-CSE (i.e., cassava farmers who were not selected to be CSEs).

seed production businesses, but may experience additional challenges to renew their rental agreements as illustrated using the excerpt below:

“There are cases where women rent land, which is usually not cleared, bushy so to speak. So, when they clear and use it in one season, more often than not, the owners tend to claim back their land because it is already clean. So, the next season, they struggle to find another piece of land for their CSE work” (KII #06, female AFF, Southern Zone).

Based on insights from the KIIs, we also established that in some regions, young men often experience restrictive social norms posed by power relations from extended family arrangements that hinder them from access and user rights of land and other resources as illustrated using the following quote:

“In the Lake Zone, there is the issue of extended families. A young man when he marries, he builds a house on the family land and he stays there with his wife. So, the [young] man does not have power to make big decisions on the use of family assets such as land. The head of the clan is the one with power of making such decisions. This poses constraints to young men who

TABLE 4 Logistic regression model of predictors of being a cassava seed entrepreneur.

| Variable | Odds ratio | SE |
|---|------------|--------|
| Sex of the farmer (1 = male) | 2.06 | 0.73* |
| Age (years) | 1.02 | 0.02 |
| Married (1 = yes) | 0.84 | 0.42 |
| Borrowed money past 12 months (1 = yes) | 1.74 | 0.57 |
| Own a bank account (1 = yes) | 3.98 | 1.32** |
| Primary education (1 = yes) | 2.76 | 1.48 |
| Secondary education (1 = yes) | 4.96 | 3.59* |
| Post secondary education (1 = yes) | 1.18 | 0.84 |
| Medium wealth status (1 = yes) | 1.32 | 0.48 |
| High wealth status (1 = yes) | 1.18 | 0.52 |
| Household size (# of members) | 0.98 | 0.04 |
| Household land size (in acres) | 1.02 | 0.02 |
| Constant | 0.08 | 0.09* |

Two hundred and ninety observations used in the logistic regression analysis. Standard errors (SE) clustered at the household level. *Significance at 0.05. **Significance at 0.01.

want to be CSEs because they do not have power of decision on the use of family resources... when he wants to buy seed he gets money from his father...even the income from seed sales becomes the income of the whole extended family” (KII #12, female AFF, Lake Zone).

Inequitable access to requisite financial resources: Insights from the IDIs showed that endowment with capital was considered as a key characteristic of being a successful CSE. However, from the interviews, we established differential access to financial resources. Contrary to the quantitative findings that classified a third of all women CSEs as having a “high” wealth status, findings from the qualitative data analysis indicated that most women CSEs identified having a lack of access to capital as a key constraint to running their seed production businesses as illustrated using the following statement:

“Capital is the most difficult part because capital is needed in preparation of land and the seed [production] too needs capital. So, without capital, it is very difficult for one to succeed” (IDI #02, younger female CSE, Successful, Lake Zone).

Indeed, for married women who are “stay-at-home” mothers, such constraints were perceived by key informants as mainly perpetuated by their spouses:

“There are women who would wish to become CSEs but the husband becomes an obstacle. They [husbands] claim that their spouses would spend family resources on CSE work. So, this hinders some women to become CSEs...some expenses are too huge that women who are stay at home mums cannot afford” (KII #06, female AFF, Southern Zone).

In circumstances where married women lack their own financial resources to move forward with their CSE activities, it was explained

that they delayed planting or starting their businesses for a whole season until they raised adequate capital to carry out their activities on their own terms.

Nonetheless, the challenge of financial resources was not only experienced by women but also by the majority of younger men CSEs, who expressed how challenging it was for them to engage in CSE work. Some cited how they forwent planting for one season, as illustrated below:

“I was trained in 2019 and started producing in 2021 [farms 4 acres]...capital was a huge challenge...that is why after the training in November 2019, I delayed [cassava seed] production until 2021...all production activities need money. So, if you do not have a tractor and money to hire it, it will be difficult to for us to continue” (IDI #11, younger male CSE, Not-so-successful, Lake Zone).

3.2.2. Influence of gendered social norms and stereotypes on becoming a cassava seed entrepreneur

Cassava farmers had to demonstrate capacity for understanding and managing business-related risks and opportunities (business acumen) and commit to record keeping if selected as CSEs and show interest in attending business trainings and trainings on good agronomic practices. Previous education, business skills training, and literacy were all considered in assessing these criteria.

Analysis of the qualitative data elucidated how gendered social norms and stereotypes around women's lower capacities shaped differential experiences to manage their seed businesses and demotivated them from carrying out their work. Such experiences were pegged on the prevailing normative gender division of labor within the household based on the expectations that women take the lead performing reproductive responsibilities that were perceived by men as being incompatible with CSE work. These often inhibited women's abilities, especially for those who were married, to take up opportunities in CSE work that required occasional travel to attend trainings on seed production as exemplified using the following excerpt:

“It is easier for men to travel freely but it is difficult for women to get permission from their spouses” (IDI #01, older female CSE, Successful, Lake Zone).

Similarly, several men CSEs demonstrated particularly inequitable attitudes toward women's rights to travel freely, which link closely with norms that disproportionately assign household and family care work to women. One male CSE asked:

“My wives should remain at home taking care of the family, so if they travel frequently, who will take care of the family?” (IDI #25, older male CSE, Successful, Eastern Zone).

Another male CSE commented on the impact of women's mobility on marital relationships by noting that:

“Many marriages end up in divorce when women travel a lot. I do not know the source, but that happens a lot in our society. If a

woman travels for a month, when she comes back home, she might find her husband married to another woman” (IDI #07, older male CSE, Successful, Lake Zone).

The above same participant reiterated that women should participate in activities that do not involve much traveling. Consequently, women who face challenges traveling outside their villages may not be able to develop the necessary knowledge and skills to carry out their CSE work if they are absent from trainings, as one woman said:

“It is hard for a person who received training to pass on the exact knowledge to another person. So, it is important if everyone will get the training by themselves” (IDI #12, older female CSE, Successful, Southern Zone).

Gendered stereotypes on business and recordkeeping skills: Insights from the qualitative data illuminated how the gender stereotypes around women's capabilities intersected with the burden of their reproductive responsibilities based on social expectations, which influence the beliefs and attitudes about their business acumen. Several men study participants expressed doubt as to whether women can be as skilled at carrying out business endeavors as men are, including because of norms around women's responsibilities for household and family-related tasks as exemplified below:

“Men are more skilled [at business]...Men are the managers of the household. Women are just taking care of the family so they [women] cannot focus on business” (IDI #19, older male CSE, Not-so-successful, Southern Zone).

The concept of “superior men” was used by some young men CSEs to justify why women cannot succeed in producing cassava seed, implying how local gender ideologies may contribute to inhibiting women's participation in economic opportunities, including in CSE work. For example, a participant stated that:

“In a group of 10 women, only 2 can succeed because men are superior in ideas than women” (IDI #21, younger male CSE, Not-so-successful, Southern Zone).

Such prevailing attitudes and stereotypes about women's business acumen may influence the self-perception and self-confidence of women CSEs. An older female CSE related:

“A man has his goals, maybe being more successful than the neighbors. For a female, it is different. You can have goals and not reach them because something in the middle distracted you. For example, myself, I am easily seduced by customers. I can even sell the seed for the amount that is not even reasonable” (IDI #15, older female CSE, Not-so-successful, Southern Zone).

In the same vein, an older male study participant observed that:

“In our community women should just be directed and let their husbands [negotiate with cassava seed clients] ... they [women] are not firm. They can easily be deceived and give favors to friends which is not acceptable in business...[if she is a CSE] she can do it if she is not married” (IDI #26, older male CSE, Successful, Eastern Zone).

Moreover, some key informants reiterated that in certain areas, community members tend to disapprove of women's engagement in business activities, noting that during recruitment of CSEs, some men expressed concern that if a woman were to become too successful, she may despise her husband.

3.2.3. Positive outcomes associated with women's engagement in cassava seed entrepreneur work

Despite the challenges experienced mainly by women CSEs of varied social identities as highlighted in the findings above, some women CSEs also expressed positive outcomes that have accrued from their participation in CSE work. These included: improved living standards characterized by better housing, increased food security, and increased incomes; enabling payment of children's school fees and the purchase of land and household goods; and enhanced social status in the community. Specifically, some women CSEs affirmed that the income generated from their seed production businesses pays more compared to producing other crops, especially considering that they sell both seed and roots, including other cassava products that they are able to process. They indicated that the use of income generated from CSE work positively changed their lives, as exemplified in the excerpts below:

"[CSE work] has transformed my life in a positive way, it has given me money that I used to pay school fees...at first, I did not have a good house and I have it now...I will continue [with CSE work] as I know it pays" (IDI #03, younger female CSE, Successful, Lake Zone).

"What makes me happy as a CSE is the income I generate from this work...I got the money and paid for my children's education and other household expenses, personal expenses and expanding the farm. I have also bought a plot of land...I have changed my life" (IDI #23, older female CSE, Successful, Eastern Zone).

Beyond income-related benefits, some women CSEs indicated additional benefits accrued from their CSE work, including increased social status and influence, which has strengthened relationships with their colleagues and community members and increased household food security. For instance, a CSE stated that:

"There are other benefits [of being a CSE] apart from money. I meet new people, I have attended different seminars and trainings, and apart from working as a CSE, the whole cassava seed production has given me a chance to travel to different places. A lot of people are directed to me from the research stations to seek for advice. They are told to look for me. This has increased my status in the society" (IDI #12, older female CSE, Successful, Southern Zone).

Some married women further elucidated that their participation in CSE work had enhanced their social status and recognition in the household accrued from their limited dependence on their spouse for financial support. Others noted that, due to the knowledge they gained during CSE training and the increased income they have been able to generate through their seed production businesses, they feel their abilities to influence household decisions regarding CSE tasks and household finances had increased. A woman CSE explained that:

"As the income increases, so does the ability to influence decisions" (IDI #02, younger female CSE, Successful, Lake Zone).

When another female CSE was asked about what she liked best about working as a CSE, she responded:

"Feeling like a super woman, as being a CSE is a huge responsibility. I dedicated a lot of my time ensuring the quality of the seeds so I can inspire other people" (IDI #13, older female CSE, Successful, Southern Zone).

4. Discussion

This mixed-methods study carried out with cassava farmers in the main cassava production zones of Tanzania has contributed to a better understanding of women's low representation in commercialized cassava seed production and has documented some of their lived experiences as they navigate the challenges and opportunities that CSE work brings. Our study has especially unraveled key drivers of intersectional gender inequalities in the cassava seed system at this relatively early stage of commercialization of the cassava value chain in Tanzania.

The quantitative component of the study identified differences between CSEs and A-CSEs in key resources that are critical to successfully function as a CSE. These differences partially explain why women and men in the latter group were not selected as seed producers by the BEST Cassava project. Our logistic regression analysis, by holding all other factors constant, found that gender and other socioeconomic biases limited women and people of lower educational and bank ownership status from participating as seed producers.

The qualitative data highlighted several challenges women face as they operated their cassava seed production businesses. Women CSEs spoke about having lower access to and control over land and financial resources (capital), which was shaped by other intersecting axes of differentiation such as marital status, age, and positional hierarchy in the family. Women CSEs also mentioned how gender stereotypes about their (lower) capacities to manage their seed businesses can demotivate them from carrying out their work. Married women CSEs have the additional burden of dealing with strong gender norms around women's family-centered roles that limit their mobilities outside their communities, which inhibits them from attending agronomic trainings on seed production. Some women CSEs, however, also expressed positive outcomes that have accrued from their participation in CSE work. These included enhanced social status in their communities and improved living standards characterized by better housing, increased food security, and the ability to afford children's school fees and purchase land and household goods.

4.1. Challenges women face as seed systems become more commercialized

It is evident that, especially given women's historical relationship with cassava, seed production can be beneficial for women as an enterprise and strengthen their roles in seed systems as they become formalized and commercialized (Puskur et al., 2021) through creating and expanding

opportunities for women's economic participation (Kandiwa et al., 2018). Nonetheless, and as similarly reported in this paper, women experience numerous barriers and constraints to successfully operating their seed production businesses due to several social and structural inequalities in seed systems (Puskur et al., 2021; Njuki et al., 2022a). These include: (i) limitations on women's mobilities (see Mudege et al., 2015; Njuguna et al., 2016; Kandiwa et al., 2018; Adam et al., 2019; Marimo et al., 2021; Njuki et al., 2022a); (ii) women's unequal access rights to production factors such as land and financial capital (Galiè et al., 2017; Nordhagen, 2020; Njuki et al., 2022a); (iii) women's lower literacy and numeracy (see Mudege et al., 2015; Kandiwa et al., 2018; Adam et al., 2019; Nordhagen, 2020; Puskur et al., 2021); (iv) gender norms and stereotypes that discriminate against women (Chiwona-Karltun et al., 1998; Mudege et al., 2015; Njuguna et al., 2016; Adam et al., 2019; Nordhagen, 2020); and (v) a heavy burden on women to perform domestic and caregiving tasks while simultaneously managing their businesses (see Mudege et al., 2015; Njuguna et al., 2016; Galiè et al., 2017; Kandiwa et al., 2018; Adam et al., 2019; Puskur et al., 2021; Njuki et al., 2022a). Consequently, such experiences reduce women's potentials to become successful commercialized seed producers, leading to a dominance of male-owned companies and operations (Kandiwa et al., 2018; Puskur et al., 2021).

Mudege and Walsh (2016) have established that most seed system programs and interventions in SSA, as was the case with the BEST Cassava project in Tanzania, often fail to acknowledge the importance of considering gender during their design and implementation phases. These programs and interventions are especially unaware of how norms that are based on the gendered division of labor and that govern gender relations can interfere with women's abilities to access and own resources and make important decisions, for example, and affect their participation in and the benefits they derive from seed production. Bullock and Crane (2021) observed that gendered social norms can pose substantial barriers to young women's and men's involvement in agricultural production. Their (lack of) involvement influences their opportunity spaces and access to key resources, which are often skewed toward men, as similarly reflected in our study findings.

In SSA, most women have low access to and control over land as their claims to land are mainly embedded in social practices and kinship relations, including marriage for which access to land may not be guaranteed. As such, women are likely to be excluded when development opportunities emerge such as participating in commercialized seed production (Collins, 2018). Where women own or are allocated land for use in seed production, it is often the least fertile and marginal lands (Mudege and Walsh, 2016) as similarly reported in our study. A qualitative study conducted in Tanzania and other African countries showed that women mainly acquire land by inheriting a portion of it from their parents or deceased husband and rarely through purchasing or renting (Doss et al., 2014). Thus, where land is owned jointly between husband and wife (or by the husband only), married women's use of the land for alternative farming arrangements may be limited (Doss et al., 2014). Without collateral or ownership deeds, securing financial resources by women for acquiring land remains nearly impossible as they are often deemed credit unworthy by financial institutions (Coles and Mitchell, 2011). Doss et al. (2014) further highlighted that decisions pertaining to financial resources are usually made by men who are the household heads, but where married women have a source of income, they can contribute to decision making processes. In addition, they noted that:

"Justification for men's greater control over all assets, resources, and decisions was that women were seen as weak, culturally inferior, and incapable of intelligent decisions. Women make resource decisions only if they are widows or if the spouse has migrated for a long time" (Doss et al., 2014, pg. 11).

The qualitative findings from our study in some ways corroborate these two statements as women were viewed rather negatively by men CSEs because of their involvement in CSE work that entails, in most cases, having greater control over resources and making important decisions. As highlighted in our results, women's limited entitlement to land, a fundamental production resource, is often embedded in informal social norms and exclusionary traditions that govern ownership and user-rights thus exacerbating gender inequalities in meeting the requisite resources for CSE work.

Despite the fact that women's individual land ownership serves as an indicator of agency (e.g., power to act), it has been argued that this in itself does not capture the structural and relational dimensions of land access and ownership that are mainly determined by gendered social norms, discriminatory institutions and local customs (Hillenbrand et al., 2015). Our findings support these insights by highlighting how gendered social norms impact on women's access to prerequisite resources for CSE work. Thus, for women to benefit as CSEs, seed system interventions should aim to understand said norms governing resource distribution that may affect the abilities of women and men, as well as youth, to benefit as commercialized seed producers (Mudege and Walsh, 2016).

It is well known that a woman's ability to move freely is often considered a key dimension of her economic and social empowerment (Hillenbrand et al., 2015). However, women's limited mobilities is considered a complex and contested issue associated with domestic and care responsibilities that inhibit them from appearing in public spaces, and thus leading to their disempowerment and marginalization (Geleta et al., 2017; Druzca and Peveri, 2018; Njuki et al., 2022a). Such restrictions on women's mobilities, particularly for those who are married, are often impeded by gendered social norms as found in our study. Hillenbrand et al. (2015) explain that risks related to women's safety and exposure to harassment are often used to justify restraining women's mobilities to maintain the status quo of men's patriarchal role of family protector. Notably, such insights were not provided by participants in this study. We acknowledge that we did not probe further to establish whether women's limited mobilities were linked to a discourse on their protection by men. Thus, future studies should consider inquiring whether this argument suffices when explaining limited mobilities of women in value chains in Tanzania.

We also established that, compared to men, most women had lower literacy, and were thus less likely to be selected as CSEs. Similarly, Coles and Mitchell (2011) observed that strong gender differences in literacy rates often disfavours women who tend to be less formally educated individuals, thus disempowering them as having less formal education limits their bargaining power.

4.2. Impact of gender-blind seed system policies and procedures

We argue that the set of CSE criteria used by the BEST Cassava project to inform their selection of CSEs was initially gender-blind, partially explaining women's low involvement as CSEs. It appears that

the cassava seed policies and regulations mainly focus on the implementation of seed standards for seed producers to improve the quality of seed production without being cognizant of the gender and social inclusion considerations. According to Galiè (2013), bringing a gender dimension to seed system policies and governance entails involving both women and the most marginal groups in decision-making processes and ensuring that governance regimes take into account the different responsibilities, priorities, and needs of women and men from different social groups and economic backgrounds. Notably, requirements such as literacy and requisite farm size may affect the abilities of women and resource-poor farmers to effectively participate in and benefit from commercialized seed production as they may not always have access to land or credit (Mudege and Walsh, 2016).

In Tanzania, Masamha et al. (2017) argued that there is need to develop policies and strategies that enable women of different social categories to participate fully in cassava seed production, and especially in making productive decisions with respect to key resources such as land, capital, time, and credit facilities. Ashby and Polar (2019) have underscored the need for promotion of equal access policies designed to level the playing field for rural women and men in terms of their access to land, capital, and other services as an approach to reduce the gender gap in opportunities and resource endowments. Mudege and Walsh (2016) have noted that when gender integration is given low priority in any program design, it remains difficult to make any meaningful changes to address gender and diversity issues during the project implementation. Therefore, understanding seed regulatory frameworks and their implications for women and men seed producers is a key step toward fostering inclusive seed business strategies (McEwan et al., 2021).

4.3. Transforming the commercialized cassava seed system in Tanzania

We propose a set of recommendations of how efforts to commercialize the cassava seed system can be modified in Tanzania to ensure that more equitable and inclusive opportunities are created for women from different social groups and economic backgrounds, and to encourage the conditions that support these women to thrive as CSEs, once selected. The “Reach-Benefit-Empower-Transform” (RBET) framework (Johnson et al., 2018; Kleiber et al., 2019) is a useful tool to help development projects to better design, monitor and evaluate their gender-related activities and distinguish between activities that aim to reach, benefit and empower women vs. those that intend to transform gendered power relations. Starting with the selection criteria, activities can be strengthened to: (1) reach more women via improved targeting and by considering key gender barriers and constraints that block or limit women’s participation as seed producers; (2) benefit more women when new cassava seed system innovations and capacity development activities get promoted and implemented; (3) economically empower women in ways that increase their profits from seed production but also their self-confidence and respect of others within their communities; and (4) transform relations between women and men at different institutional levels that limit women’s decision-making powers and access to and control over

resources that are needed to be successful seed producers. Our recommendations are grouped according to a few thematic areas of concern and include specific actions that were informed by the RBET framework.

4.3.1. Modify the cassava seed entrepreneur selection criteria

The CSE selection criteria should be modified to be gender-responsive and transformative in its design and use. Per the selection criteria described in Table 1, we suggest some ways projects that aim to assist in the commercialization of cassava seed systems can be more deliberate in their use and implementation of gender aware and intersectional approaches.

Financial resources: financial products should be developed and made available with low interest rates for women and youth to start up and grow their seed production businesses. Financial products need to consider the specific needs and circumstances of women and youth to ensure they do not falter on their payments and fall into debt. These efforts would be in addition to creating opportunities for women and youth to access local savings and lending groups in Tanzania such as Village Community Banks (see Kilombe et al., 2023 for an overview) and training programs designed to help women develop concrete plans to grow their seed production businesses and overall asset base for the longer term.

Business acumen and record keeping capacity: literacy and numeracy training should also be provided to women to strengthen their business and record-keeping skills. This could be combined with agronomy skills training using a blended learning approach that considers differences in formal education and literacy and numeracy skills between and among women and men. Literacy and numeracy training should be developed in a manner that does not exclude women who do not have formal education. Efforts to engage men to support women’s ambitions and opportunities as CSEs should also be made using gender transformative methodologies. Exemplar cases of successful women CSEs from different social groups and economic backgrounds could be communicated as one means of helping transform negative stereotypes about women’s business capacities.

Availability of land: projects must make concerted efforts to understand customary land tenure and residence norms especially for married and cohabiting couples to determine how community leaders and male spouses/partners, who often govern land and other natural resources in rural areas, could facilitate equitable access to land for use, ownership, and development by women. According to the latest report on the status of women in agri-food systems (FAO, 2023), a lower share of women own land and/or have secure tenure rights compared to men, including in Tanzania. Where land is challenging to access through local institutions, the financial products that get developed for women could enable them to purchase or rent land as one key asset needed to start up their seed production businesses. Concerning the minimum isolation distances from nearby cassava fields that CSEs need to adhere to when producing seed, women’s capacities could be strengthened to negotiate with neighboring landowners to cultivate crops other than cassava next to their seed fields. In addition, efforts could be made to further engage community leaders to develop by-laws that protect seed producers and to advocate for adherence to by-laws for increased seed availability in the community.

Proximity of land to roads: women and men farmers who do not have access to lands close to well-trafficked roads should not be excluded from becoming a CSE. Projects must work with women and men farmers to help them identify alternative options for access routes to their cassava seed production fields if they are not nearby roads. It is critical that alternatives are identified (or ruled out) before any investments are made in assisting women and men with setting up their seed production businesses.

Training interest: given that there are relatively few formal/structured agronomic, business, and other types of training opportunities created for farmers in rural areas in Tanzania, it is presumed that many farmers have an interest in attending trainings to strengthen their CSE skills and capacities (or for other reasons). The use of a gender-responsive approach would ensure that all trainings take place close to the homes of women CSEs and during times of the day that enable women to join without putting them at risk of backlash from their family members. The use of a gender transformative approach would address the gendered norms around domestic and care work and engage men to share the burden of this work more equitably to enable greater participation in trainings by women CSEs.

Farming acumen: the production and supply of improved cassava seed can be an important source of livelihood for women and men farmers in addition to their other farming activities. Farm diversification enables farmers to spread their risk across different production activities, thus increasing their resilience to shocks and stresses such as climate change (Hertel et al., 2021). However, farmers (and especially women) should be made aware of any potential risks associated with their involvement in seed production as devoting too many resources into one activity usually means fewer resources available for investing in other activities (e.g., production of food crops). Risks for women are often (very) different from those experienced by men (Jones et al., 2017). Strengthening skills and capacities of farmers, especially women and youth, to make well-informed decisions on all farming matters should be part and parcel of any project working with cassava seed producers.

4.3.2. Develop and pilot gender-responsive training, technologies, and financial services

In addition to providing the gender-responsive training and financial products mentioned above, it is equally important for projects to help develop and/or facilitate access to labor- and time-saving cassava seed production and other relevant farming technologies given women's disproportionate involvement in unpaid, domestic work and drudgery. For example, the use of locally fabricated two-row mechanical cassava planter and harvester for which the planter can plant 7 to 10 hectares in a day while the mechanical lifter can harvest up to 3 to 5 hectares of cassava on a daily basis, thus reducing the labor costs, drudgery and root damage (Technologies for African Agricultural Transformation, 2021).

4.3.3. Use gender transformative approaches

Projects should engage men when working with women CSEs to strengthen their awareness and encourage their support, including using household methodologies (see Farnworth et al., 2018) that also promote joint goal setting between women CSEs and their spouses and/or other family members. At the community level, projects can

implement behavior change communication interventions that build critical consciousness (see Cornwall, 2016) of gender equality, human rights, and other related social issues among community members. There is growing evidence that the use of these and other gender transformative interventions can bring about positive gender and agricultural development outcomes (Cole et al., 2020; McDougall et al., 2021).

4.3.4. Develop and pilot mentorship programs for women

Identify a diverse group of women CSEs, who have had success in running their businesses, to mentor other women CSEs as they start up their seed production businesses. Such a mentorship program could focus on a variety of topics ranging from providing coaching or guidance on good agronomic and business practices to good tips on bargaining for more financial/human resource support from within the household and for increased rights to travel freely for business or other reasons outside the household to building self-esteem and -confidence. The program could help develop (or strengthen existing) women's groups and networks within the cassava seed system, which have been shown to enable women to overcome gender-related barriers and increase their participation in rural entrepreneurship (Semkunde et al., 2022).

4.3.5. Establish robust monitoring, evaluation, and learning systems

We strongly suggest that projects set up a monitoring, evaluation, and learning system to detect and address (if needed) any unintended or negative consequences of women's involvement in the production and sale of cassava seed at both household and community levels.

4.4. Study limitations

One study limitation that we identified is that we did not undertake in-depth interviews with the cassava farmers who were identified but not selected to participate as CSEs. This was not a methodological bias of our study design but rather deliberate given that A-CSEs had not been selected to participate in cassava seed production, and therefore, could not comment on the challenges and successes like their CSE counterparts. However, we acknowledge that we could have carried out in-depth interviews with A-CSEs to better understand from their perspectives why they were not selected for CSE work. Such perspectives would have strengthened the overall study design and provided key insights to inform future research and development programs that develop similar criteria to the BEST Cassava project for selecting CSEs.

5. Conclusion

Our study contributes to a better understanding of the drivers of intersectional gender inequalities in commercialized cassava seed systems, thus serving as one entry point for rethinking how to make seed systems more gender-responsive and transformative for greater gender and social equality. Given the complexity of women's involvement in seed production in low-income country contexts, if

they are to benefit from such work, they need to be involved in making decisions about how to commercialize seed production. Stakeholders who are leading the current cassava seed system development efforts in Tanzania must adopt gender aware and intersectional approaches to address the underlying biases that exclude and/or marginalize women and other social groups from participating in and benefiting from commercialized seed production. Stakeholders should consider combining social change innovations with more “technical” seed system interventions to address the discriminatory social and gender norms and unequal power relations that create unique barriers and constraints for women and youth to take up work and operate effectively as cassava seed producers. Such efforts could help in leveling the playing field for a more socially inclusive and sustainable commercialized cassava seed system in Tanzania.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the International Institute of Tropical Agriculture Internal Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

ML: conceptualization, methodology, data analysis, writing—original draft preparation, and review and editing the manuscript. SC: conceptualization, supervision, study design and methodology, data analysis process, writing—original draft preparation, and review and editing the manuscript. DM: conceptualization, study design and methodology, data collection and analysis, and writing—review and editing the manuscript. LB: conceptualization, study design and methodology, data analysis, and writing—review and editing the manuscript. NS and AW: conceptualization, study design and methodology, writing—review and editing the manuscript, and

funding acquisition. HT: writing—review and editing the manuscript. RK: conceptualization, writing—review and editing the manuscript, and funding acquisition. All authors contributed to the article and approved the submitted version.

Funding

This work was undertaken with funding from the “Building an Economically Sustainable Seed System in Tanzania for Cassava” project. Funding to support write-up and analysis efforts of select co-authors was provided by the “Muhogo Bora” Better Cassava for all project in Tanzania funded by an anonymous foundation donor and the Harnessing Gender and Social Equality for Resilience in Agrifood Systems (HER+) Initiative.

Acknowledgments

The authors would like to thank all funders who supported the HER+ Initiative through their contributions to the CGIAR Trust Fund: <https://www.cgiar.org/funders/>. We appreciate the support during the study of all MEDA staff in Tanzania who implemented the BEST Cassava project. We also wish to acknowledge the important contributions of the members of the data collection team to this study. We appreciate the guidance provided by Shiferaw Feleke during quantitative data analysis. And a special thanks to all the CSEs and A-CSEs who participated in the study for their time and valuable insights.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

- Adam, R. I., Kandiwa, V., David, S., and Muindi, P. (2019). *Gender-responsive approaches for enhancing the adoption of improved maize seed in Africa: A training manual for seed companies*. Mexico, CIMMYT.
- Akram-Lodhi, H., and Komba, I. (2018). What are the factors driving the gender gap in agricultural productivity in Tanzania? Available at: [https://info.undp.org/docs/pdc/Documents/TZA/Final report gender gap April 2018.Pdf](https://info.undp.org/docs/pdc/Documents/TZA/Final%20report%20gender%20gap%20April%202018.pdf)
- Andersson, K., Lodin, J. B., and Chiwona-Karlton, L. (2016). TGender dynamics in cassava leaves value chains: The case of Tanzania. *Journal of Gender, Agriculture and Food Security*, 1, 84–109. <https://agrigender.net/uploads/JGAFS-122016-5-Paper.pdf>
- Ashby, J. A., and Polar, V. (2019). “The implications of gender relations for modern approaches to crop improvement and plant breeding,” in *Gender, agriculture and agrarian transformations*. Ed. Sachs, C. E., Routledge. doi: 10.4324/9780429427381-2
- Bennett, B., Naziri, D., Mahende, G., and Towo, E. (2012). Driving Demand for Cassava in Tanzania: The next Steps. <https://gatesopenresearch.org/documents/3-360>
- Bullock, R., and Crane, T. (2021). Young Women's and Men's opportunity spaces in dairy intensification in Kenya. *Rural. Sociol.* 86, 777–808. doi: 10.1111/ruso.12385
- Chiwona-Karlton, L., Mkumbira, J., Saka, J., Bovin, M., Mahungu, N. M., and Rosling, H. (1998). The importance of being bitter—a qualitative study on cassava cultivar preference in Malawi. *Ecol. Food Nutr.* 37, 219–245. doi: 10.1080/03670244.1998.9991546
- Cole, S. M., Kaminski, A. M., McDougall, C., Kefi, A. S., Marinda, P. A., Maliko, M., et al. (2020). Gender accommodative versus transformative approaches: a comparative assessment within a post-harvest fish loss reduction intervention. *Gender, Technol. Develop. Special Issue Gender Fish*. 24, 48–65. doi: 10.1080/09718524.2020.1729480

- Coles, C., and Mitchell, J. (2011). Gender and agricultural value chains: a review of current knowledge and practice and their policy implications. FAO, ESA. 11–05. Available at: <http://www.fao.org/docrep/013/am310e/am310e00.pdf>
- Collins, A. M. (2018). Old habits die hard: the need for feminist rethinking in global food and agricultural policies. *Canadian Food Studies / La Revue canadienne des études sur l'alimentation* 5, 19–38. doi: 10.15353/cfs-rcea.v5i1.228
- Cornwall, A. (2016). Women's empowerment: what works? *J. Int. Dev.* 28, 342–359. doi: 10.1002/jid.3210
- Crenshaw, K. (1991). Mapping the margins: intersectionality, identity politics, and violence against women of color. *Stanford Law Rev.* 43, 1241–1299. doi: 10.2307/1229039
- Doss, C., Kim, S. M., Njuki, J., Hillenbrand, E., and Miruka, M. (2014). Women's individual and joint property ownership: Effects on household decisionmaking. IFPRI Discussion Paper 1347. Washington, D.C.: International Food Policy Research Institute (IFPRI), <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/128149>
- Druzca, K., and Peveri, V. (2018). Literature on gendered agriculture in Pakistan: neglect of women's contributions. *Women's Stud. Int. Forum* 69, 180–189. doi: 10.1016/j.wsif.2018.02.007
- FAO (2023). The status of women in agrifood systems. *Rome*. doi: 10.4060/cc5343en
- Farnworth, C. R., Stirling, C. M., Chinyophiro, A., Namakhoma, A., and Morahan, R. (2018). Exploring the potential of household methodologies to strengthen gender equality and improve smallholder livelihoods: research in Malawi in maize-based systems. *J. Arid Environ.* 149, 53–61. doi: 10.1016/j.jaridenv.2017.10.009
- Fischer, E., and Qaim, M. (2012). Gender, agricultural commercialization, and collective action in Kenya. *Food Security* 4, 441–453. doi: 10.1007/s12571-012-0199-7
- Forsythe, L., Posthumus, H., and Martin, A. (2016). A crop of one's own? Women's experiences of cassava commercialization in Nigeria and Malawi. *Journal of Gender, Agriculture and Food Security* 1, 110–128.
- Galiè, A. (2013). Governance of seed and food security through participatory plant breeding: empirical evidence and gender analysis from Syria. *Nat. Res. Forum* 37, 31–42. doi: 10.1111/1477-8947.12008
- Galiè, A., Jiggins, J., Struik, P. C., Grando, S., and Ceccarelli, S. (2017). Women's empowerment through seed improvement and seed governance: evidence from participatory barley breeding in pre-war Syria. *NJAS-Wageningen J. Life Sci.* 81, 1–8. doi: 10.1016/j.njas.2017.01.002
- Geleta, E. B., Elabor-Idemudia, P., and Henry, C. (2017). Scaling-up: gender integration and women's empowerment in southern Ethiopia. *Cogent Food Agricul.* 3, 1–16. doi: 10.1080/23311932.2017.1415100
- Hancock, A. M. (2007). When multiplication Doesn't equal quick addition: examining intersectionality as a research paradigm. *Perspect. Polit.* 5, 63–79. doi: 10.1017/S1537592707070065
- Hankivsky, O. (2014) *Intersectionality 101*. A report of the Institute for Intersectionality Research & Policy, SFU: Canada.
- Hertel, T., Elouafi, I., Tanticharoen, M., and Ewart, F. (2021). Diversification for enhanced food systems resilience. *Nature Food* 2, 832–834. doi: 10.1038/s43016-021-00403-9
- Hillenbrand, E., Karim, N., Mohanraj, P., and Wu, D. (2015). *Measuring gender-transformative change a review of literature and promising practices*. United States: CARE USA Working Paper.
- Johnson, N., Balagamwala, M., Pinkstaff, C., Theis, and S., Meinzen-Dick, R. (2018). How do agricultural development projects empower women? Linking strategies with expected outcomes. *J. Gender, Agricul. Food Security* 3, 1–19. doi: 10.22004/ag.econ.293596
- Jones, N., Holmes, R., Presler-Marshall, E., and Stavropoulou, M. (2017). Transforming gender constraints in the agricultural sector: the potential of social protection programmes. *Glob. Food Sec.* 12, 89–95. doi: 10.1016/j.gfs.2016.09.004
- Kabeer, N. (2005). Gender equality and women's empowerment: a critical analysis of the third millennium development goal 1. *Gend. Dev.* 13, 13–24. doi: 10.1080/13552070512331332273
- Kandiwa, V., Adam, R., Lweya, K., Setimela, P., Badstue, L., and Muindi, P. (2018). *Gender-responsive approaches for the promotion of improved maize seed in Africa*. Mexico, CIMMYT.
- Kilombele, H., Feleke, S., Abdoulaye, T., Cole, S., Sekabira, H., and Manyong, V. (2023). Maize productivity and household welfare impacts of mobile money usage in Tanzania. *Int. J. Financial Stud.* 11:27. doi: 10.3390/ijfs11010027
- Kleiber, D., Cohen, P., Gomes, C., and McDougall, C. (2019). *Gender-integrated research for development in Pacific coastal fisheries*. Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems.
- Langevang, T., Hansen, M. W., and Rutashobya, L. K. (2018). Navigating institutional complexities: the response strategies of Tanzanian female entrepreneurs. *Int. J. Gen. Entrep.* 10, 224–242. doi: 10.1108/IJGE-02-2018-0015
- Legg, J. P., Diebiru-Ojo, E., Eagle, D., Friedmann, M., Kanju, E., Kapinga, R., et al. (2022). "Commercially sustainable cassava seed systems in Africa" in *Root, tuber and banana food system innovations*. ed. G. Thiele (Berlin: Springer), 1–583.
- Marimo, P., Otieno, G., Njuguna-Mungai, E., Vernooy, R., Halewood, M., Fadda, C., et al. (2021). The role of gender and institutional dynamics in adapting seed systems to climate change: case studies from Kenya, Tanzania and Uganda. *Agriculture* 11, 1–26. doi: 10.3390/agriculture11090840
- Masamba, B., Thebe, V., and Uzokwe, V. N. E. (2018). Mapping cassava food value chains in Tanzania's smallholder farming sector: the implications of intra-household gender dynamics. *J. Rural. Stud.* 58, 82–92. doi: 10.1016/j.jrurstud.2017.12.011
- Masamba, B., Uzokwe, V. N. E., and Thebe, V. (2017). Women's empowerment in traditional food value chains at the micro level: evidence from cassava smallholder farming in Tanzania. *Agroecol. Sustain. Food Syst.* 42, 28–47. doi: 10.1080/21683565.2017.1325433
- McDougall, C., Badstue, L. B., Mulema, A. A., Fischer, G., Najjar, D., Pyburn, R., et al. (2021). "Toward structural change: Gender transformative approaches", in *Advancing gender equality through agricultural and environmental research: Past, present, and future*. Eds. Pyburn, R. and van Eerdewijk, A. [Washington, DC: International Food Policy Research Institute (IFPRI)], 365–402.
- McEwan, M. A., Almekinders, C. J. M., Andrade-piedra, J. J. L., Delaquis, E., Garrett, K. A., Kumar, L., et al. (2021). "Breaking through the 40% adoption ceiling: mind the seed system gaps." A perspective on seed systems research for development in one CGIAR. *Outlook Agricul.* 50, 5–12. doi: 10.1177/0030727021989346
- Meinzen-Dick, R., Bernier, Q., and Haglund, E. (2013). The six "ins" of climate-smart agriculture: *Inclusive institutions for information, innovation, investment, and insurance*. CAPRI Working Paper No. 114. Washington, D.C.: International Food Policy Research Institute.
- Mikocheni Agricultural Research Institute, Dar Es Salaam, Tanzania Mtunguja, M. K., Beckles, D. M., University of California, Davis, USA Laswai, H. S., Sokoine University of Agriculture, Morogoro, Tanzania et al. (2019). Opportunities to commercialize cassava production for poverty alleviation and improved food security in Tanzania. *Afr. J. Food Agric. Nutr. Dev.* 19, 13928–13946. doi: 10.18697/ajfand.84.BLFB1037
- Ministry of Agriculture. (2020). National Cassava Development Strategy (NCDS) 2020–2030. Available at: https://www.kilimo.go.tz/uploads/CASSAVA_DEVELOPMENT_STRATEGY.pdf
- Mudege, N. N., Nyekanyeka, T., Kapalasa, E., Chevo, T., and Demo, P. (2015). Understanding collective action and women's empowerment in potato farmer groups in Ntcheu and Dedza in Malawi. *J. Rural. Stud.* 42, 91–101. doi: 10.1016/j.jrurstud.2015.09.002
- Mudege, N. N., and Walsh, S. (2016). Gender and roots tubers and bananas seed systems: a literature review. CGIAR research program on roots, tubers and bananas (RTB) working paper, Lima, Peru.
- Njuguna, E. M., Liani, M. L., Beyene, M., Ojiewo, C. O., and Ababa, A. (2016). Exploration of cultural norms and practices influencing women's participation in chickpea participatory varietal selection training activities: a case study of Adaa and Ensaro districts, Ethiopia. *J. Gender, Agricul. Food Security* 1, 40–63. doi: 10.19268/JGAFS.132016.3
- Njuki, J., Eissler, S., Malapit, H., Meinzen-Dick, R., Bryan, E., and Quisumbing, A. (2022a). A review of evidence on gender equality, women's empowerment, and food systems. *Glob. Food Sec.* 33:100622. doi: 10.1016/j.gfs.2022.100622
- Njuki, J., Melesse, M., Sinha, C., Seward, R., Renaud, M., Sutton, S., et al. (2022b). Meeting the challenge of gender inequality through gender transformative research: lessons from research in Africa, Asia, and Latin America. *Canadian J. Develop. Stud. Revue canadienne d'études du développement* 44, 206–228. doi: 10.1080/0225189.2022.2099356
- Njuki, J., and Sanginga, C. P. (2013). Women, Livestock Ownership and Markets: Bridging the gender gaps in Eastern and Southern Africa. Available at: <http://idl-bnc.idrc.ca/dspace/bitstream/10625/52269/1/IDL-52269.pdf>.
- Nordhagen, S. (2020). Supporting gender equity through food system businesses in lower-income countries. GAIN working paper series 13. Available at: <https://www.gainhealth.org/sites/default/files/publications/documents/gain-working-paper-series-13-supporting-gender-equitable-food-systems-through-access-to-finance-for-small-and-medium-sized-companies.pdf>
- Nweke, F. I. (2001). *The cassava transformation: Africa's best-kept secret*. Michigan State University Press, East Lansing, Michigan.
- Nweke, F. I. (2004). *New challenges in the cassava transformation in Nigeria and Ghana*. Environment and Production Technology Division, International Food Policy Research Institute. United States.
- Puskur, R., Mudege, N. N., Njuguna-Mungai, E., Nchanji, E., Vernooy, R., Galiè, A., et al. (2021). 'Moving beyond reaching women in seed systems development', in *Advancing gender equality through agricultural and environmental research: Past, present, and future*, pp. 113–145. Available at: <https://www.kit.nl/wp-content/uploads/2021/11/Advancing-Gender-Equality-through-Agricultural-and-Environmental-Research.pdf>.
- Reincke, K., Vilvert, E., Fasse, A., Graef, F., Sieber, S., and Lana, M. A. (2018). Key factors influencing food security of smallholder farmers in Tanzania and the role of cassava as a strategic crop. *Food Security* 10, 911–924. doi: 10.1007/s12571-018-0814-3
- Semkundu, M. A., Elly, T., Charles, G., Gaddefors, J., and Chiwona-Karltun, L. (2022). Rural entrepreneurship and the context: navigating contextual barriers through women's groups. *Int. J. Gen. Entrep.* 14, 213–234. doi: 10.1108/IJGE-01-2021-0013
- Sikira, A. N., and Kashaigili, J. J. (2016). Gendered access and control over land and water resources in the southern agricultural growth corridor of Tanzania. *J. Natural Resour. Develop.* 6, 108–117. doi: 10.5027/jnrnd.v6i0.12
- Sonnwald, U., Fernie, A. R., Gruissem, W., Schläpfer, P., Anjanappa, R. B., Chang, S. H., et al. (2020). The Cassava Source-Sink Project: Opportunities and Challenges for Crop Improvement by Metabolic Engineering. *Plant Journal* 103, 1655–1665. doi: 10.1111/tpj.14865
- Technologies for African Agricultural Transformation. (2021). Cassava Technology Toolkit Catalogue. Clearinghouse Technical Report Series 006, Clearinghouse Office, IITA, Cotonou, Benin. 30 pp. Available at: <https://taat-africa.org/wp-content/uploads/2021/04/Cassava-Technology-Toolkit-Catalogue.pdf>
- Teeken, B., Olaosebikan, O., Haleegoah, J., Oladejo, E., Madu, T., Bello, A., et al. (2018). Cassava trait preferences of men and women farmers in Nigeria: implications for breeding. *Econ. Bot.* 72, 263–277. doi: 10.1007/s12231-018-9421-7