



Published in final edited form as:

*AIDS Behav.* 2023 January ; 27(1): 245–256. doi:10.1007/s10461-022-03760-z.

## The impact of land tenure security on a livelihood intervention for people living with HIV in western Kenya

Afker K Daniel<sup>1,2</sup>, Shari L Dworkin<sup>3</sup>, Annie McDonough<sup>4</sup>, Abigail M Hatcher<sup>5,6</sup>, Rachel Burger<sup>7</sup>, Elly Weke<sup>8</sup>, Pauline Wekesa<sup>8</sup>, Elizabeth A Bukusi<sup>8,9</sup>, George Owino<sup>8</sup>, Gladys Odhiambo<sup>8</sup>, Harsha Thirumurthy<sup>10</sup>, Monica Getahun<sup>7</sup>, Sheri D Weiser<sup>11</sup>, Craig R Cohen<sup>7</sup>

<sup>1</sup>Department of Medicine, Massachusetts General Hospital, Boston, MA, USA

<sup>2</sup>Department of Pediatrics, Massachusetts General Hospital, Boston, MA, USA

<sup>3</sup>School of Nursing and Health Studies, University of Washington, Bothell, Bothell, WA, USA

<sup>4</sup>Department of Neurology, University of California, San Francisco, San Francisco, CA, USA

<sup>5</sup>Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

<sup>6</sup>School of Public Health, University of Witwatersrand, Johannesburg, South Africa

<sup>7</sup>Department of Obstetrics, Gynecology & Reproductive Sciences, University of California, San Francisco, San Francisco, CA, USA

<sup>8</sup>Centre for Microbiology Research, Kenya Medical Research Institute, Nairobi, Kenya

<sup>9</sup>Department of Obstetrics and Gynecology, University of Washington, Seattle, WA, USA

<sup>10</sup>Department of Medical Ethics and Health Policy, Perelman School of Medicine, Philadelphia, PA, USA

<sup>11</sup>Division of HIV, Infectious Diseases, and Global Medicine, University of California, San Francisco, San Francisco, CA, USA

### Abstract

Few studies have explored land access, a structural driver of health, and women's participation in livelihood interventions to improve food security and HIV outcomes. This qualitative study, embedded within *Shamba Maisha* (NCT02815579) – a randomized controlled trial (RCT) examining the impact of a multisectoral intervention among farmers living with HIV in western

**Corresponding Author:** Afker Daniel, 17 Clapp Street, Malden, MA, 02148, Phone: +1 781 325 2928, afker.daniel@gmail.com. Authors' contributions: The author's responsibilities were as follows: AKD, AMH, SLD, RB, EAB, SDW, and CRC designed the research; AKD conducted the research, wrote the paper with support from CRC, SDW and SLD, and had primary responsibility for the final content; AM, AD, AH, SDW and CRC analyzed the data; all authors read and approved the final manuscript.

Conflicts of interest/Competing interests: The authors have no conflicts of interest to declare that are relevant to the content of this article.

Ethics approval: Ethical approval for the study was granted by the Scientific and Ethical Review Unit (SERU) of the Kenya Medical Research Institute (KEMRI) as well as the UCSF Committee on Human Research.

Consent to participate: Written, informed consent was obtained from all study participants.

Consent for publication: There are no individual participants for whom identifying information is included in this article.

Code availability: Dedoose

Kenya - sought to explore the influence of perceived access to and control of land on agricultural productivity, investments, and benefits. Thirty in-depth interviews (IDIs) were conducted with purposively sampled men and women, three to six months after receiving intervention inputs; data were deductively and inductively coded and analyzed. Farming practices and participation in *Shamba Maisha* were dependent on land tenure and participants' perceived strength of claim over their land, with participants who perceived themselves to be land insecure less likely to make long-term agricultural investments. Land tenure was influenced by a number of factors and posed unique challenges for women which negatively impacted uptake and success in the intervention. Data underscore the importance of secure land tenure for the success of similar interventions, especially for women; future interventions should integrate land security programming for improved outcomes for all.

## Keywords

HIV; livelihood interventions; food insecurity; Kenya; land tenure

---

## Introduction

Structural inequities, including land tenure and food insecurity, negatively impact HIV prevention and care. Structural factors - physical, social, cultural, organizational, community, economic, legal, or political aspects of an individual's environment - can impede or facilitate efforts to prevent and treat HIV by shaping or constraining individual risk and access to treatment (1-4). Land tenure is an important structural factor linked to HIV risk and vulnerability, particularly among populations who rely on agriculture for their livelihoods (5,6). Men and women farmers who are more secure in their land tenure are more likely to invest in land, labor and inputs and are far more likely to have increased agricultural productivity compared to farmers with less secure access to land (7-14). Land tenure also directly impacts food security, with studies showing that land tenure strengthening interventions can have significant positive effects on food availability and body mass index (13-15).

All these effects of land tenure insecurity are compounded for women, who face more severe and frequent property rights violations than men (16,17). In sub-Saharan Africa (SSA), under customary practices, women depend on men - through marriage, family and kinship - for access to land and housing (5,18,19) despite women comprising more than 43% of the agricultural labor force worldwide and generating 80% of the food grown in most developing countries (16,20,21). Because men are generally recognized as the heads of households and hold possession of land title documentation, women are particularly vulnerable to loss of land access during land disputes upon the death of a husband or patriarch; this is further exacerbated in high HIV seroprevalence settings, where husbands' death from HIV highly stigmatizes surviving widows (5,18,22-24). Even in SSA countries where legislation upholds women's property rights (for example, Kenya), gaps in statutory implementation leave women with little recourse for securing land tenure during disputes (18,25). Therefore, local officials and traditional leaders who preside over informal land dispute resolution continue to rely on customary practices that ultimately deny women

access to and control over land (18,26). The resulting loss of access to shelter, social support systems and livelihood strategies often leads to forced migration; further, mobility and migration increase instances of transactional sex, and the probability of experiencing physical and sexual violence, all of which contribute to increased HIV risk, poverty, and lack of access to medical care (5,6,27–32).

Previous studies have also demonstrated the intricate and bi-directional relationship between HIV and food insecurity (33–36). Food insecurity, defined as a lack of access to nutritious and safe food or the inability to safely and reliably procure food (34,37), increases the risk of HIV acquisition and decreases adherence of people living with HIV (PLHIV) to HIV care, thereby increasing morbidity and mortality (36–43). HIV in turn exacerbates food insecurity by reducing economic productivity, increasing medical expenses and negatively impacting social support systems due to societal stigma (37,44–46). Both HIV and food insecurity disproportionately impact individuals in resource-poor settings, especially women, who comprise 58% of PLHIV in SSA and of whom 25.2% are considered food insecure (47,48). In many Kenyan counties, subsistence farming and fishing are the foundation of the local economy; greater than 75% of the Kenyan population is involved in agriculture as a form of income (52). Yet, due to decreased precipitation climate patterns, low agricultural productivity, and poor agricultural policies and infrastructure, food insecurity is widespread in Kenya, where an estimated 1.3 million people experience food insecurity (53,54). In the three Kenyan counties where our study takes place (Homa Bay, Migori, and Kisumu), the average prevalence of HIV is 16.7%, more than 3 times the national average of 5.9% (55).

Research has underscored the importance of structural interventions - operating at the population or community level - for targeting food insecurity to improve HIV prevention, risk reduction and treatment outcomes (1,24,49–51). Despite the promising evidence for livelihood interventions' positive impact on HIV health outcomes (24,50,51), there is a paucity of research on how degree of access to and control over land impacts the uptake and success of these interventions on improving health outcomes (e.g., adherence to treatment, consistency of follow up, morbidity and viral suppression) among PLHIV. The *Shamba Maisha* (Kiswahili for “farm life”) study—an agricultural and financial intervention among farmers living with HIV (LHIV) in Kenya—offers a unique opportunity to examine how access to and control over land impact participation and engagement in a structural intervention. This qualitative sub-study, embedded within the broader *Shamba Maisha* trial, sought to explore how land tenure security might have influenced uptake and success of the *Shamba Maisha* intervention.

## Methods

### Study Design

This qualitative study was nested within *Shamba Maisha*, a cluster RCT examining the impact of a multisectoral agricultural intervention among farmers LHIV in western Kenya (#NCT02815579). Eight (n=8) matched pairs of Ministry of Health (MOH) facilities were selected across Migori, Homa Bay and Kisumu counties and randomized to intervention or control. These facilities were selected based on: size, minimum number of PLHIV receiving

treatment at the facility, geography and proximity to sources of water for irrigation. Data were collected at one time point for each cluster, 3-6 months after participants received intervention implements.

### Study Recruitment

Study participants for the broader *Shamba Maisha* RCT were recruited through meetings and announcements at the MOH health facilities. Men and women (18-60 yrs.) were eligible if they were receiving ART, belonged to a patient support group, had access to farming land and surface water or shallow well, had evidence of moderate to severe food insecurity (based on the Household Food Insecurity Access Scale (65)) and/or malnutrition (BMI <18.5) at baseline or during the year prior to enrollment in the RCT, and were willing to save the down payment (~20 USD) required to receive the microfinance commodity loan. All participants were also required to demonstrate access to land for agricultural production during enrollment. Participants were screened thrice, including: (1) verbal confirmation and willingness for the study to assess access to farming land no more than 46 meters from a water source, and access to surface water accessible at a depth not exceeding 7 meters at all times of year; (2) home visits to confirm access to land per the above requirements; and (3) confirmation of desire to participate and study enrollment. At enrollment, participants were categorized into one of five land access groups based on demonstrated land holdings: (1) freehold (permanent ownership), (2) documents showing permission to occupy land, (3) customary (ownership based on local traditions), (4) informally occupied land, (5) rented or leased.

Intervention participants received a three-pronged intervention, comprised of (1) agricultural implements (including a human-powered water pump, fertilizers, and pesticides), (2) a loan of ~\$175, and (3) education in sustainable agricultural practices and financial literacy. Participants at control sites were eligible to receive the intervention at the end of the study period. All participants received HIV/AIDS care and treatment, including ART, in accordance with Kenyan Ministry of Health standards. By design, approximately half the participants were male and half were female.

### Qualitative Sampling

Thirty (n=30) in-depth interviews were conducted with a systematically and purposively selected subset of n=15 female and n=15 male participants from six intervention sites only, as the primary objective of this sub-study was to examine the impacts of perceived land tenure on intervention uptake and engagement. Interviews of control participants were conducted after final follow-up visit at 24 months after enrollment in the *Shamba Maisha* RCT. These interviews examined themes related to climate change and pregnancy, but did not probe on the topic of intervention perceptions, in part since the control participants were not exposed to the intervention. For geographic and socioeconomic diversity, two sites were in peri-urban areas (Kisumu County) and four sites were among rural populations (Migori and Homa Bay Counties). Participants were interviewed at one time point between January and March 2018, at least 3-6 months after starting the intervention.

## Data Collection

Interviews were conducted by two gender-matched, trained qualitative researchers fluent in English and local languages (Kiswahili and Dholuo) at participants' homes or preferred locations. Researchers (GO and GA) were trained by the lead investigator (AKD) and collected the data. The semi-structured interview guide domains explored perceptions of land security, land inheritance and documentation processes, capabilities and knowledge in the agricultural domain, and perceived impacts of the agricultural intervention on household decision-making, gendered-power and gender roles. The guide also included specific probes on land investments, land disputes, land-related and household decision-making, and changes experienced by participants in health and self-confidence since joining the intervention arm of the study. Participants' land tenure security was defined in this study as an individual's perceived sense of reliable access to and decision-making power over their land holdings (63–64). In order to examine participants' engagement and feelings of success with the intervention, data in this paper focuses on interview domains that probed on perceived land access and decision-making control over land, investments in land, and gender-based differences in land access. Interviews lasted between 1 – 2 hours and were digitally recorded. Each researcher led the process of transcription and translation for interviews they conducted from local languages into English. At least one study investigator reviewed each transcript to gauge for clarity in translation and documentation and to provide feedback to interviewers to guide future interviews.

## Analysis

Transcripts were coded using Dedoose (Sociocultural Research Consultants, LLC, Manhattan Beach, CA), a qualitative data management software program. In collaboration with the interview team, two investigators (AKD and AM) inductively and deductively developed a coding framework, first based on domains of inquiry in the interview guide which were guided by the literature and second on emergent themes from early interviews. Using the coding framework, inter-rater reliability was established by double coding a random selection of ten transcripts for review and comparison by AKD and AM. The coding framework was iteratively refined on the basis of emergent findings within the first ten transcripts and then applied to all transcript segments using Dedoose. All interviews were then independently double-coded by two investigators (AKD and AM) using the thematic framework. Analytical memos were developed which summarized major themes and highlighted exemplar and divergent quotes that illustrated participant experiences and views. The results that follow examine land tenure-based differences in perspectives by comparing data from male and female participants who defined themselves as land 'secure' versus those who identified as land 'insecure'. Gender-based variations were explored by comparing data from women and men in the sub-study.

## Ethical Approvals

Written, informed consent was obtained from all study participants. Ethical approval for the study was granted by the Scientific and Ethical Review Unit (SERU) of the Kenya Medical Research Institute (KEMRI) as well as the University of California San Francisco Human Subjects Research Committee.

## Results

### Demographic Characteristics

Characteristics of the study participants are outlined in Table 1 and Table 2. Participants (50% women) ranged from 22 to 56 years (median age of 42.5 years, IQR: 39-50 years). Average time on ART was 4-5 years. Seventy-three percent (70%) of participants were married; 26% were widowed. Among women, 6.7% were married with multiple partners, compared to 20% for men. More than 80% of both women and men had 2 or more children in their household. With regard to education (Table 2), 50% of male participants had a secondary education or higher, compared to 20% for female participants.

### Main Findings

Interviewees described livelihood benefits from their participation in *Shamba Maisha*, including increased income and enhanced farming and cultivation practices. These led to perceived improvements in the four mediating factors in *Shamba Maisha's* causal pathway for HIV outcomes: food security, mental health, physical health, and an increased sense of agency and self-confidence (34). One participant described the many gains he experienced during *Shamba Maisha*:

“[Since joining Shamba Maisha,] I am steady and my strength has improved. Even when my CD4 was tested it was found to be high. It was 400 and now it has gone up to 700, there is improvement. My weight has also increased; I was 68kg and now I am 72kg. There is adequate strength to do my work because I eat well. I no longer experience [HIV related illnesses]. I have never been sick nor admitted to the hospital for sickness - I just do my work...Stress is not there because I can get food anytime and the money that was a problem to me now is available because of my hard work. Before Shamba Maisha stress could be there because you could not raise money to buy the vegetables, the child also would need maybe 50 shillings for school and you don't have it but now if he or she comes you will have the money.”  
(41-year-old man, Homa Bay County)

Yet, across interviews, participants described their approach to farming practices and level of involvement in *Shamba Maisha* as heavily dependent on land tenure and the strength of their claim over their land. Findings revealed that this sense of land security (or lack thereof) strongly influenced decision-making around several factors important to intervention participation and success.

Participants' land tenure security was defined in this study as an individual's perceived sense of reliable access to and decision-making power over their land holdings (63–64). This access to and control over land was affected by several factors that increased or decreased participants' sense of land tenure security, thereby resulting in varied levels of engagement with the intervention. Thus, the positive pathways that participants reported as benefits of the improved farm productivity and increased income supported by the *Shamba Maisha* intervention hinged on their ability to securely access land.

We identified three major themes from interview analysis regarding the relationship between land tenure, land security, participant uptake and impact of *Shamba Maisha*. In the first theme, land tenure security varied among participants according to several factors, including written documentation of land ownership, gender, and community acceptance. Second, land tenure security posed unique challenges for women, with important implications for their continued participation and success in the intervention. Third, land tenure security directly impacted participants' decision-making around early components of the *Shamba Maisha* intervention, including initial crop selection and purchases of agricultural equipment, both of which participants were less likely to invest in if they perceived themselves to be land tenure insecure.

### **Theme 1: Perceived Strength of Land Tenure: Key Influencers of Perceived Land Security among *Shamba Maisha* Participants**

During interviews, the majority of participants (76.6% among both men and women) described themselves as feeling secure about their access to the land used for the intervention. Reasons described by participants for this sense of security included possession of written agreements verifying land holdings, strong confidence in interpersonal relationships (both at the community and family levels), lack of previous land disputes, and environmental factors (e.g., secure access to water, reliable climate patterns, protection from wildlife). Men were more likely to endorse feeling secure about their land holdings compared to women who, due to titling practices, usually did not have any independent holdings over land.

For almost all participants who felt secure about their land access, possession of some sort of documentation tying them to their land helped improve a sense of security. Types of written documentation included parcel numbers, informal written agreements and title deeds, with title deeds holding the most leverage. Written documentation provided participants assurances during land disputes, collateral for taking out loans and making investments, and confidence in securing returns from long-term investments. One female interviewee noted that this is especially true for women, claiming:

“Having a title deed makes one to be courageous. Having a title deed gives you a lot of courage even if you are a woman...[because] with the title deed one feels stronger; you are closer to the government and in case of any disputes, you can produce the title while the other person cannot. The one with a title deed wins the case.” (53-year-old woman, Migori County)

Most participants who did have title deeds, which were primarily associated with tenure over ancestral or family land, noted that the land and deed was not actually registered to their name, but that of an elder or ancestor. Interestingly, this discrepancy did not necessarily lead to a sense of insecurity since, as one participant stated, “even the villagers know that it is my farm.” In other words, even though the title deed is in someone else's name, there is a perception that this still produces an understanding in the family and community about who has rights over certain pieces of land. However, not all participants were able to overlook this inconsistency, with one female participant expressing that she would prefer to have written proof linking her more closely to the title deed:

“...the title deed is in the name of my father-in-law; if my husband can change the title deed to his name because definitely, I have his name I’ll feel more secure because if he’s not around today [if he dies], the title deed will read his name and my name will read his name so I’ll feel more secure.” (34-year-old woman, Kisumu County)

Though written documentation was reported as the most concrete form of land security, it is important to note that this was not always the case. One participant reported that individuals could fraudulently pay for the processing of a title deed without consulting or checking with the current owner or local chiefs:

“Yes, I am not secure because anybody can come from somewhere and say it is their land and produce title deed, you never know...” (54-year-old man, Kisumu County)

Thus, participants described that title deeds provide clear land security; however, not all interviewees enjoyed this security and many worried that it was still possible for others to lay claims on their land without much recourse. In our next theme, we examine how land security was impacted by gender dynamics.

## **Theme 2: Gender, Land Tenure Security and *Shamba Maisha***

In addition to higher perceived land insecurity, women were also more likely to experience land disputes with less recourse for resolution, especially when their husbands passed away. One woman recounts the story of an acquaintance saying:

“...he came back home and sent away the brother’s wife and took away her land and even demolished the door to her house; how can you help such a case? You just leave because there is nothing she can do; she doesn’t have any power on her own and there is no way she can go about it so you just leave and move to start a life in town...” (39-year-old woman, Homa Bay County)

Many participants described the challenges widows faced in frequent land grabbing disputes and in establishing long-term protection over their land. One woman described the situation of a widowed *Shamba Maisha* participant saying:

“There are thieves there...they would come in motorcycles at night, place the vegetables in sacks and go away. [The women who lived there] were almost giving up and I told them that that’s how it is; you are widows and so no one can take the mandate to guard for you your farms.” (38-year-old woman, Kisumu County)

Men, in contrast, were much more likely to express feeling secure in their land holdings, even if they were still in the process of establishing their title deeds (which was the case for most interview participants). One farmer noted:

“I feel so secure... I have confidence [in my] ownership of my land and feel secure and that I can do anything related to *Shamba Maisha* on it...The reason why I feel secure with it [is because] we were given allotment numbers from the lands ministry that is verifiable [and] my elder brother has encouraged us to process our



titles whenever we are able to by taking my father's title and his death certificate, which means I can process my title even now." (49-year-old man, Migori County)

Interestingly, some interviewees who themselves were widowed women (and therefore shared their experiences from a first-person perspective) often described a stronger sense of decision-making power over their land holdings compared to married female participants, even if they were involved in new partnerships. Widows were reportedly no longer legally bound to a male head of household, and so, in some instances, could be independently allotted land in a way acceptable to their husband's family after his passing; these women appeared to hold the strongest decision-making power in their household over their land. One widow who became involved in a new partnership after her husband's death described this nuance:

"The difference [between my current partner and my late husband] is that the land belongs to [my late husband] but this other old man [my current partner] has come from his own home and we just stay together as partners who have found each other and stay together. [But] he has no land here. The land belongs to [my late husband]. That's why if I tell [my] current partner that I want to grow vegetables here and he refuses, I'll [still] grow them. I only tell him to make him aware but it doesn't mean that I have to abandon my plan [if he refuses]." (41-year-old woman, Migori County)

These sentiments were further corroborated by a married woman who was asked if the customary practice of wife inheritance - whereby a woman is customarily expected to enter a new sexual partnership after the passing of her husband (66) - renders widows less secure over their land tenure and reduces their decision-making power. This participant noted that because a widow is not obligated to marry an 'inheritor' she might actually possess more power in this dyad:

"Maybe, because he [the inheritor] is not [a widow's] true husband, he has come and found [her] there so [she] must have more power. [In that situation] how can he speak in [her] house? He can leave at any time he wants if he can't live with [her] terms." (39-year-old woman, Homa Bay County)

Ultimately, women - whether married or widowed - consistently expressed greater perceived land insecurity than men. In our next theme, we explore how perceived land tenure security influenced participant engagement and level of investment in the *Shamba Maisha* intervention.

### **Theme 3: Impact of Land Tenure and Land Security on *Shamba Maisha* Farming and Income**

About one-quarter of interview participants described themselves as land insecure, and almost all participants reported that their perception of land security was an important factor in their ability to successfully participate in *Shamba Maisha*. One participant, who was uncertain about the strength of his land tenure, noted that "[worryes about land] affect [*Shamba Maisha*] because when you start worrying you don't feel encouraged hence [you are] not able to proceed with work properly but just do very little." This discrepancy in intervention engagement between participants who perceived themselves to be land tenure

secure versus insecure was especially evident in decisions made with regard to short- and longer-term investments in farming and income-generating activities, including crop selection, equipment purchases and construction.

**Crop Selection**—Perceptions of land security shaped crop selection by impacting participants' willingness to invest in more expensive crops with extended harvesting times. At enrollment and during agricultural training, all *Shamba Maisha* participants were supplied with an initial number of seeds with which to begin farming on their land. While agricultural trainers provided some guidance and recommendations as part of the intervention arm, all participants were given the freedom to select which crops they preferred to produce on their farms. In addition, participants could supplement their initial supply of seeds with any additional crops they felt would improve their productivity for sustenance and income generation. Participants cultivated crops from this initial supply of seeds, the most common being: kale, African black nightshade, cowpeas, and spider plant. These crops provided subsistence for the household, could be harvested relatively quickly and sold in local markets. One participant explained the benefits of this baseline crop selection for all participants saying:

“I chose spider plant, black nightshade, capsicum and coriander. Black nightshade has good money especially [in the] dry season and people like it, the same [goes] for spider plant. I also chose collards because it is fast in growth and can be harvested for about 4-5 months. Capsicum also has an attractive price in the market.” (39-year-old man, Kisumu County)

However, most participants who felt secure about access to the land they used for *Shamba Maisha* tended to supplement this starter set of seeds with additional crops, many of which would not produce quick returns due to longer growing times and more intensive cultivation periods. This set of “long-term” crops included cassava, pumpkin, butternut squash and fruit trees (e.g., mango, orange, avocado), some of which can take between 4 and 15 years to reach full maturity. Indeed, a few participants who felt land tenure secure already had these additional crops on their land:

“I already have mangoes and guava trees in my farm so there is no need to plant others [trees].” (47-year-old woman, Kisumu County)

When asked to explain his reasoning for selecting fruit trees, another land tenure secure participant noted that:

“...fruits that [take a] little longer to mature...bring money [just like] vegetables and maize...like oranges can also help my children because fruits are good for one's health” (50-year-old man, Kisumu County)

In contrast, participants who perceived themselves to be land insecure were less likely to invest in additional crops, especially long-term crops. One participant explained why she refrained from growing mangos and other fruit trees:

“...[because] the owner of the farm may claim it back before the tree crops mature up. [Then what] - would I cut them down or leave them for him?” (46-year-old woman, Kisumu County)

Even land tenure secure participants affirmed that their decision making around crop selection would have been different had their access to land used for *Shamba Maisha* been more precarious. Several land secure participants stated that they would have completely forgone their decision to plant fruit trees and instead planted maize, a staple and cash crop, since “*the cost of maize production is low, but these other ones are costly such that you cannot grow them where you are not sure of [your access to land]*”, (39-year-old man, Kisumu County). Thus, land tenure security was an important factor that intervention participants considered in deciding which crops to plant, including those requiring greater investment and longer periods before bearing fruit.

**Investment in Equipment and Construction**—Most participants based their decisions to invest in equipment, construction and labor on their perceived land tenure security, which provided some participants with the assurance required to make significant investments in their land. However, if access to land was uncertain, participants were less likely to make high-cost additional investments in equipment and construction, including fencing and labor. One participant stated:

“...just the seeds alone that I use [are expensive], for example watermelon of about 50 grams is close to 17,000 KSH (~\$170 USD) and even the tomatoes I have right now [are] 50 grams for 7,500 KSH (~\$75 USD) and I have planted three of such [and] that totals to 22,500 KSH (~\$225 USD). So, it is a huge amount that you cannot invest in a place that you are not sure of...and that is just seeds, you have not included tilling the land and leasing costs and other work on the land like drainage system...[then] when it reaches the time to harvest, you also spray pesticides after every two weeks. It totals to a lot of money that you cannot take to a place that you have a feeling that the owner may change their mind [take the land away from you before harvest]” (51-year-old man, Kisumu County)

Another participant who felt insecure about her land holdings due to lack of a title deed, expressed several changes she would make in her approach to farming had she more certainty around her access to land, saying:

“[If I had the title deed,] I would fence [the land] and grow more crops...the fence helps to keep off intruders.” (56-year-old woman, Kisumu County)

When asked about her plans to build trenches to protect against hippos, another participant who had informally occupied her land for the study noted:

“Actually, I have thought of [building trenches] but my hands are tied, because long-term investments on someone else’s farm is quite a challenge.” (34-year-old woman, Kisumu County)

In contrast most participants who perceived that they were land secure stated they were more willing to make additional up-front investments in their farms, alongside longer-term projects such as erecting fences, digging trenches to protect against encroachment by hippos, and hiring additional labor. One male participant who felt himself to be land tenure secure described several additional investments he made in equipment and structures around his farm, including plans to extend his land used for farming saying that:

*“I added some equipment, for example Shamba Maisha did not give me a wheelbarrow, I had to buy [this] and a spade and a net to cover [the] tree nursery because there are some vegetables that must go through nursery before transplanting...and there was also a pipe that we added for extension to cover the entire land...and another plan is to extend the land because the one I have is not enough, the demand [for produce] sometimes is high but supply is low” (41-year-old man, Homa Bay County)*

When one land tenure secure participant was asked if she would have still built a fence around her land without certainty about land access, she stated:

*“Why would I do such on someone else’s land! What if I get chased away from the land? Would I pluck off my banana crops and run away with them? I wouldn’t fence off the farm; I must fence my own farm, one that belongs to me. You can only fence if the land is yours.” (40-year-old woman, Kisumu County)*

Participants with land tenure security were more confident making additional investments in their land through purchasing equipment and tools, and hiring labor to complete more intensive farm improvements like fencing and digging trenches.

## Discussion

This is one of the first studies to examine how a livelihood intervention seeking to improve HIV outcomes is impacted by the extent to which participants experience land insecurity. Without this understanding, “success” in such interventions may be skewed towards those who were more land secure. Those who experience land insecurity may have their agricultural decision making, income and health impacted during the course of their intervention participation. This is the first study to attempt to understand whether those who participated in an RCT designed to improve HIV outcomes through a multisectoral agriculture livelihood intervention experienced discrepancies and challenges in access to and control over land. In addition, we sought to understand whether those who perceived they were more land secure differed in important ways from those who perceived themselves to be land insecure, particularly in terms of gender and possession of written documentation demonstrating land tenure. Our study showed that gender did shape perceived land security, with women more often perceiving themselves to be land insecure. Our study also interestingly showed that possession of written documentation did not necessarily correlate with perceptions of land insecurity (though the literature shows that documentation is crucial in measures of actual land security and recourse in the event of land disputes) (14,16,22,24,56). Second, our study showed that variability in perception of security in access to and control over land shaped how individuals made decisions about intervention participation, namely in terms of the types of crops and other agricultural investments they made to improve productivity of their land. This impacted both agricultural yield and income generation, key variables in the *Shamba Maisha* randomized controlled trial.

In this study, we found that while intervention participants living with HIV perceived that *Shamba Maisha* was able to improve their health and food security, success and engagement with this livelihood intervention was shaped by participants’ perception of security in access

to and control over land. The strength of a participant's sense of land security depended on a number of factors, including customary and legal rules governing access to land. Participants with some sort of written documentation over their land, especially a title, were more likely to express a sense of land security and capacity to make decisions about their land freely. Still, the fact that most participants reported feeling secure in their access to land without having a title or other documentation suggests that possession of written documentation is not imperative to a perception of land security in this context. Many participants put more confidence in land tenure that was substantiated by their family, community and community leaders through community meetings or public declarations.

Compared to male participants in *Shamba Maisha*, women in our study experienced more restricted access to land and higher land tenure insecurity. Women in our study were less likely to report having any kind of documentation or formal agreement tying them to their land. At the same time, they were more likely to have a history of being involved in land disputes and to hesitate in making long-term investments in their land. A growing body of literature suggests that this type of land tenure insecurity significantly hinders women's ability to achieve financial security, sustain housing, and establish household bargaining power (5,25,31,56–61). The resulting elevated risk of poverty, forced migration, and gender-based imbalances in relationship power puts women at higher risk of HIV acquisition and poorer health outcomes (5,27,47) and points to the role that strengthened land tenure security and property rights might have in reinforcing structural HIV interventions.

Fearing they would be stripped of their access to land, certain intervention participants opted to make shorter term investments in their farming practices. They planted crops that would garner income quickly (though perhaps less sustainably) and avoided investing in agricultural products and equipment that would help them care for and protect their cultivation land (fertilizer, fences, trenches, etc.). While this is a common reaction to land tenure insecurity, literature shows that when farmers make these kinds of trade-offs, it contributes to a cycle of continued low agricultural productivity and hinders sustained livelihood benefits (7,10,14,62). Men and women farmers who feel more secure about their land tenure are more likely to invest in land, labor and inputs and are far more likely to have increased agricultural productivity compared with farmers who feel less secure about their access to land (7,9–12,14,62,63). Our results suggest that land tenure security seems to influence farmers' ability to benefit from an intervention like *Shamba Maisha* through two related mechanisms: (1) creating sustainable income generation and (2) shaping a reliable yield of crops that could be used for sustenance. In turn, there were three primary drivers that increased or decreased participants' perceived sense of land tenure security: 1) national laws regarding land ownership and access, 2) local customs that framed the practical application of property rights, and 3) gender – with women being greatly limited in their capacity for investing in the intervention due to strong perceived land tenure insecurity. Our proposed pathway (Figure 1) illustrates how all of these factors influenced the four primary mediators (empowerment, mental health, physical health and food security) in *Shamba Maisha*'s causal pathway for improving HIV outcomes.

Our study offers unique insights into the perceived mechanisms through which interventions targeting structural determinants of health might offer more sustainable and more successful

integrated benefits to agricultural communities and people living with HIV. These pathways have important implications both for the scale up of *Shamba Maisha* and the development of similar structural HIV interventions that seek to implement long-lasting and self-sustaining agricultural programs. Many participants reported health and socioeconomic benefits from *Shamba Maisha*, and we hypothesize that the quantitative data will support these qualitative findings. However, in order to maximize success for individuals such as those included in our study, the mediating impact of land tenure security must be considered early in project planning stages. Program planners should develop partnerships with community groups to support knowledge dissemination around property rights, dispute mitigation and land tenure security strengthening. Furthermore, structural livelihood interventions in the future may need to integrate property rights programming that assists with establishing land security in order to more adequately recognize gender-based disparities in land tenure and its impact on health outcomes.

There are important limitations to our study. First, the sample size for this qualitative study does not include control participants who did not receive the *Shamba Maisha* intervention. This decision was made so that our study could focus on how perceived land tenure security impacted intervention participants. In addition, all study participants, both intervention and control, had some access to land meaning that there was perhaps selection bias in our sample against members of the community who were the most land insecure. Valuable insights would be gained from interviewing individuals outside of the study population which should be included in future studies. Finally, rules governing land tenure and property rights, both customary and at the national level, vary significantly. Our focus on perceived land tenure was an attempt to mitigate this limitation by focusing on subjective interpretations of land security rather than those more officially outlined in Kenyan law and custom. However, this evaluation of perceived land tenure security also has its own significant limitations since this does not objectively measure actual land tenure security and is therefore difficult to quantify and replicate, especially since there can be a disjuncture between perceived and actual land tenure security. In addition, though this paper focused on legal and cultural factors that impacted land tenure security, there are important environmental factors, such as droughts and wildlife encroachment, that we did not examine here but future studies should consider.

Rigorous agricultural interventions, such as *Shamba Maisha*, that aim to improve HIV treatment and care outcomes have great potential for improving HIV health in some of the world's most vulnerable populations. However, for such livelihood interventions to be as effective as possible, they should consider incorporating measures and practices to promote land tenure security (especially for women) or combine agricultural interventions with property rights interventions. It will be important to secure land access and control for those who have no access to a title or documentation linking them to their land or who are HIV positive. This could be done through partnerships with community-based land rights protection interventions and organizations (such as GROOTS-Kenya or the Federation of Women Lawyers in Kenya (FIDA-Kenya) (27,67)). Findings from this study can guide the creation of future agricultural and economically-oriented development and public health interventions by emphasizing secure land access and empowerment as integral to generating sustainable outcomes in communities heavily affected by HIV. Building on our findings, additional studies should aim to use quantitative data to structure the framework

and methodology through which both subjectively perceived and more objective actual land tenure security are measured in the development of livelihood interventions. These findings should be incorporated into future iterations or scale-up of programs similar to *Shamba Maisha* and integrated into assessments of their sustainable impact on HIV health outcomes.

## Acknowledgments

We thank A. Rain Mocello for her assistance with data organization and analysis and the Shamba Maisha research assistants for recruiting participants. We acknowledge the Kenya Medical Research Institute–University of California at San Francisco (KEMRI–UCSF) Collaborative Group, Family AIDS Care and Education Services (FACES), the Director of KEMRI, the Director of KEMRI’s Centre for Microbiology Research, and Nyanza Provincial Ministries of Health, for their logistical support in conducting this research.

### Funding:

This study was supported by the Doris Duke Charitable Foundation (to AKD) and NIH grant NIH/NIMH R01MH107330-01 (to CRC).

### Availability of data and material:

Transcripts may be requested by permission through request to AKD.

## References

1. Gupta GR, Parkhurst JO, Ogden JA, Aggleton P, Mahal A. Structural approaches to HIV prevention. *Lancet*. 2008;372(9640):764–75. [PubMed: 18687460]
2. Seeley J, Watts CH, Kippax S, Russell S, Heise L, Whiteside A. Addressing the structural drivers of HIV: A luxury or necessity for programmes? *J Int AIDS Soc*. 2012;15(Suppl 1):15–8. [PubMed: 22417404]
3. Siu GE, Wight D, Seeley J. How a masculine work ethic and economic circumstances affect uptake of HIV treatment: Experiences of men from an artisanal gold mining community in rural eastern Uganda. *J Int AIDS Soc*. 2012;15(Suppl 1):1–9.
4. Musheke M, Bond V, Merten S. Individual and contextual factors influencing patient attrition from antiretroviral therapy care in an urban community of Lusaka, Zambia. *J Int AIDS Soc*. 2012;15(Suppl 1):1–9.
5. Dworkin SL, Grabe S, Lu T, Hatcher A, Kwena Z, Bukusi E, et al. Property rights violations as a structural driver of women’s HIV Risks: a qualitative study in Nyanza and Western Provinces, Kenya. *Arch Sex Behav*. 2013;42(5):703–13. [PubMed: 23179234]
6. Muchomba FM, Wang JSH, Agosta LM. Women’s land ownership and risk of HIV infection in Kenya. *Soc Sci Med [Internet]*. 2014;114:97–102. Available from: 10.1016/j.socscimed.2014.05.055 [PubMed: 24922606]
7. Lawry S, Samii C, Hall R, Leopold A, Hornby D, Mtero F. The impact of land property rights interventions in investment and agricultural productivity in developing countries: a systematic review. *J Dev Eff*. 2017;9(1):61–81.
8. Besley T Property rights and investment incentives: theory and evidence from Ghana. *J Polit Econ*. 1995;103(5):903–37.
9. Ghebru H, Khan H, Lambrecht I. Perceived land tenure security and rural transformation: Empirical evidence from Ghana. IFPRI Discuss Pap 1545. 2016;
10. Abdulai A, Owusu V, Goetz R. Land tenure differences and investment in land improvement measures: theoretical and empirical analyses. *J Dev Econ*. 2011;96(1):66–78.
11. Ali DA, Dercon S, Gautam M. Property rights in a very poor country: tenure insecurity and investment in Ethiopia. *Agric Econ Int Assoc Agric Econ*. 2011;42(1):75–86.
12. Goldstein M, Udry C. The profits of power: Land rights and agricultural investment in Ghana. *J Polit Econ*. 2008;116(6):981–1022.

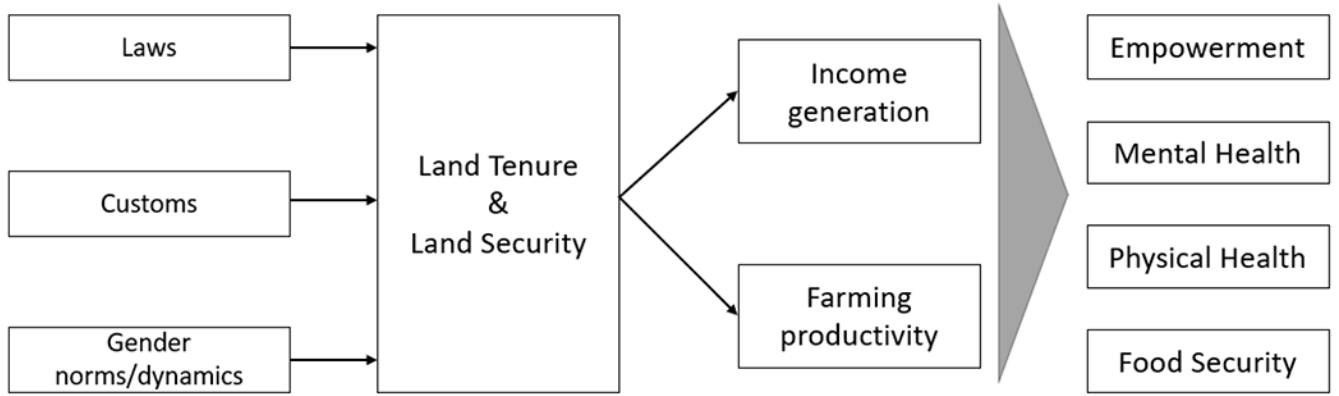
13. Hagos HG, Holden S. Links between Tenure Security and Food Security: Evidence from Ethiopia. ESSP Work Pap 59. 2013;
14. Holden ST, Ghebru H. Land tenure reforms, tenure security and food security in poor agrarian economies: Causal linkages and research gaps. *Glob Food Sec* [Internet]. 2016;10:21–8. Available from: 10.1016/j.gfs.2016.07.002
15. Roth M USAID Issue Brief: Land Tenure and Food Security. 2012.
16. Namubiru-Mwaura E Land tenure and gender: approaches and challenges for strengthening rural women's land rights. *Women's voice, agency & participation research series: Gender equality and development*. 2014.
17. 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. [PubMed: 21280416]
18. Lu T, Zwicker L, Kwena Z, Bukusi E, Mwaura-Muiru E, Dworkin SL. Assessing barriers and facilitators of implementing an integrated HIV prevention and property rights program in Western Kenya. *AIDS Educ Prev*. 2013;25(2):151–63. [PubMed: 23514082]
19. Walsh J Women's Property Rights Violations and HIV/AIDS in Africa. *Peace Rev A J Soc Justice*. 2005;17(2–3):189–95.
20. Giovarelli R, Beatrice W, Hannay L. USAID Issue Brief, Land Tenure, Property Rights, and Gender: Challenges and approaches for strengthening women's land tenure and property rights, property rights and resource governance briefing paper #7. 2013;1–15.
21. (FAO) F and AO of the UN. The State of Food and Agriculture, 2010-2011: Women in Agriculture: Closing the Gender Gap for Development. Rome, Italy; 2011.
22. Deere CD, León M. Who owns the land? Gender and land-titling programmes in Latin America. *J Agrar Chang*. 2001;1(3):440–67.
23. Turan JM, Hatcher AH, Medema-Wijnveen J, Onono M, Miller S, Bukusi EA, et al. The role of HIV-related stigma in utilization of skilled childbirth services in rural Kenya: A prospective mixed-methods study. *PLoS Med*. 2012;9(8).
24. Hilliard S, Bukusi E, Grabe S, Lu T, Hatcher AM, Kwena Z, et al. Perceived impact of a land and property rights program on violence against women in rural Kenya: A qualitative investigation. *Violence Against Women* [Internet]. 2016;22(14):1682–703. Available from: <https://www.scopus.com/inward/record.uri?eid=2-s2.0-84992471327&partnerID=40&md5=1acd794a00ba9c96a23804fc226fecaa> [PubMed: 26951306]
25. Strickland RS. To have and to hold: Women's property and inheritance rights in the context of HIV/AIDS in sub-Saharan Africa [Internet]. 2004. Available from: <https://www.icrw.org/publications/womens-property-rights-as-an-aids-response-lessons-from-community-interventions-in-africa/>
26. The International Women's Human Rights Clinic & Kenya Federation of Women Lawyers International. Women's land and property rights in Kenya - Moving forward into a new era of equality: A human rights report and proposed legislation. *Georg J Int Law* [Internet]. 2008;40:49–64. Available from: [http://www.google.com/url?sa=t&rc=j&q=&esrc=s&source=web&cd=1&ved=0CCgQFjAA&url=http%3A%2F%2Fwww.law.georgetown.edu%2Facademics%2Fflaw-journals%2Fgjil%2Fupload%2F3-PropertyReportFIXED2.pdf&ei=mwbuUuaQCavG7Ab464GoBQ&usq=AFQjCNGcTTbFTo48\\_j3KLId5HA2qjgAq2w&s](http://www.google.com/url?sa=t&rc=j&q=&esrc=s&source=web&cd=1&ved=0CCgQFjAA&url=http%3A%2F%2Fwww.law.georgetown.edu%2Facademics%2Fflaw-journals%2Fgjil%2Fupload%2F3-PropertyReportFIXED2.pdf&ei=mwbuUuaQCavG7Ab464GoBQ&usq=AFQjCNGcTTbFTo48_j3KLId5HA2qjgAq2w&s)
27. Dworkin SL, Gandhi M, Passano P, editors. *Women's Empowerment and Global Health: A Twenty-First-Century Agenda*. Oakland, California: University of California Press; 2017.
28. Swaminathan H, Ashburn K, Kes A, Duvvury N, Walker C, Aliber M, et al. Women's property rights, HIV and AIDS, and domestic violence: Research findings from two rural districts in South Africa and Uganda [Internet]. Cape Town, South Africa: HSRC Press; 2008. Available from: <http://www.icrw.org/publications/womens-property-rights-hiv-and-aids-and-domestic-violence>
29. Shi C-F, Kouyoumdjian FG, Dushoff J. Intimate partner violence is associated with HIV infection in women in Kenya: A cross-sectional analysis. *BMC Public Health*. 2013;13:512–9. [PubMed: 23711189]



30. Burroway R A cross-national analysis of sex-specific HIV prevalence rates and women's access to property, land, and loans in developing countries. *Int J Sociol.* 2012;42(2):47–67.
31. Aliber M, Walker C. The impact of HIV/AIDS on land rights: perspectives from Kenya. *World Dev.* 2006;34(4):704–27.
32. Izumi K, editor. *Reclaiming our lives: HIV and AIDS, women's land and property rights and livelihoods in southern and East Africa: narratives and responses.* HSRC Press; 2006.
33. Larson BA, Fox MP, Rosen S, Bii M, Sigei C, Shaffer D, et al. Early effects of antiretroviral therapy on work performance: Preliminary results from a cohort study of Kenyan agricultural workers. *AIDS.* 2008;22(3):421–5. [PubMed: 18195569]
34. Weiser SD, Young SL, Cohen CR, Kushel MB, Tsai AC, Tien PC, et al. Conceptual framework for understanding the bidirectional links between food insecurity and HIV/AIDS. *Am J Clin Nutr.* 2011;94 (suppl):1729S–1739S. [PubMed: 22089434]
35. Weiser SD, Tsai AC, Gupta R, Frongillo EA, Kawuma A, Senkungu J, et al. Food insecurity is associated with morbidity and patterns of healthcare utilization among HIV-infected individuals in a resource-poor setting. *AIDS* [Internet]. 2012;26(1):67–75. Available from: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00002030-201201020-00008> [PubMed: 21904186]
36. Nagata JM, Magerenge RO, Young SL, Oguta JO, Weiser SD, Cohen CR. Social determinants, lived experiences, and consequences of household food insecurity among persons living with HIV/AIDS on the shore of Lake Victoria, Kenya. *AIDS Care - Psychol Socio-Medical Asp AIDS/HIV.* 2012;24(6):728–36.
37. Weiser SD, Palar K, Frongillo EA, Tsai AC, Hunt PW, Ragland K, et al. Longitudinal assessment of associations between food insecurity, antiretroviral adherence and HIV treatment outcomes in rural Uganda. 2015;28(1):115–20.
38. Weiser SD, Leiter K, Bangsberg DR, Butler LM, Percy-De Korte F, Hlanze Z, et al. Food insufficiency is associated with high-risk sexual behavior among women in Botswana and Swaziland. *PLoS Med.* 2007;4(10):1589–98. [PubMed: 17958460]
39. Weiser SD, Fernandes KA, Brandson EK, Lima VD, Anema A, Bangsberg DR, et al. The association between food insecurity and mortality among HIV-infected individuals on HAART. *J Acquir Immune Defic Syndr.* 2009;52(3):342–9. [PubMed: 19675463]
40. Weiser SD, Bukusi EA, Steinfeld RL, Frongillo EA, Weke E, Dworkin SL, et al. Shamba Maisha: Randomized controlled trial of an agricultural and finance intervention to improve HIV health outcomes in Kenya. *AIDS.* 2015;29(14):1889–94. [PubMed: 26214684]
41. Anema A, Weiser SD, Fernandes KA, Ding E, Brandson EK, Palmer A, et al. High prevalence of food insecurity among HIV-infected individuals receiving HAART in a resource-rich setting. *AIDS Care - Psychol Socio-Medical Asp AIDS/HIV.* 2011;23(2):221–30.
42. Tsai AC, Hung KJ, Weiser SD. Is food insecurity associated with HIV risk? Cross-sectional evidence from sexually active women in Brazil. *PLoS Med.* 2012;9(4).
43. Young S, Wheeler A, McCoy S, Weiser SD. A review of the role of food insecurity in adherence to care and treatment among adult and pediatric populations living with HIV and AIDS. *AIDS Behav.* 2014;18(Suppl 5):S505–15. [PubMed: 23842717]
44. Gregson S, Mushati P, Nyamukapa C. Adult mortality and erosion of household viability in AIDS-afflicted towns, estates, and villages in eastern Zimbabwe. *J Acquir Immune Defic Syndr.* 2007;44(2):188–95. [PubMed: 17075384]
45. Russell S The economic burden of illness for households in developing countries: A review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. *Am J Trop Med Hyg.* 2004;71(Suppl 2):147–55. [PubMed: 15331831]
46. Tsai AC, Bangsberg DR, Emenyonu N, Senkungu JK, Martin JN, Weiser SD. The social context of food insecurity among persons living with HIV/AIDS in rural Uganda. *Soc Sci Med.* 2011;73(12):1717–24. [PubMed: 22019367]
47. Zakaras JM, Weiser SD, Hatcher AM, Weke E, Burger RL, Cohen CR, et al. A qualitative investigation of the impact of a livelihood intervention on gendered power and sexual risk

- behaviors among HIV-positive adults in rural Kenya. *Arch Sex Behav.* 2017;46(4):1121–33. [PubMed: 27507020]
48. FAO, IFAD, UNICEF W and W. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security [Internet]. Rome; 2017. Available from: <http://www.fao.org/3/i7695en/i7695en.pdf>
  49. Degenhardt L, Mathers B, Vickerman P, Rhodes T, Latkin C, Hickman M. Prevention of HIV infection for people who inject drugs: Why individual, structural, and combination approaches are needed. *Lancet* [Internet]. 2010;376(9737):285–301. Available from: 10.1016/S0140-6736(10)60742-8 [PubMed: 20650522]
  50. Pronyk PM, Hargreaves JR, Kim JC, Morison LA, Phetla G, Watts C, et al. Effect of a structural intervention for the prevention of intimate-partner violence and HIV in rural South Africa: a cluster randomised trial. *Lancet.* 2006;368(9551):1973–83. [PubMed: 17141704]
  51. Kadiyala S, Rawat R, Roopnaraine T, Babirye F, Ochai R. Applying a programme theory framework to improve livelihood interventions integrated with HIV care and treatment programmes. *J Dev Eff.* 2009;1(4):470–91.
  52. United States Agency for International Development U. USAID Issue Brief: Kenya agricultural and food security fact sheet [Internet]. 2020. Available from: <https://www.usaid.gov/documents/1860/agriculture-and-food-security>.
  53. Oluoko-Odingo AA. Vulnerability and adaptation to food insecurity and poverty in Kenya. *Ann Assoc Am Geogr.* 2011;101(1):1–20.
  54. United States Agency for International Development U. Kenya Food Insecurity Fact Sheet #1, Fiscal Year (FY) 2015 [Internet]. 2015. Available from: [https://www.usaid.gov/sites/default/files/documents/1866/kenya\\_fi\\_fs01\\_09-30-2015.pdf](https://www.usaid.gov/sites/default/files/documents/1866/kenya_fi_fs01_09-30-2015.pdf)
  55. National AIDS Control Council. Kenya HIV county profiles 2016 [Internet]. Nairobi, Kenya; 2016. Available from: [http://nacc.or.ke/wp-content/uploads/2016/12/Kenya-HIV-County-Profiles-2016.pdf%0Ahttp://www.nacc.or.ke/attachments/article/464/KenyaCountyProfilesBook\\_Nov\\_print.pdf](http://nacc.or.ke/wp-content/uploads/2016/12/Kenya-HIV-County-Profiles-2016.pdf%0Ahttp://www.nacc.or.ke/attachments/article/464/KenyaCountyProfilesBook_Nov_print.pdf)
  56. Walker C Land reform in southern and eastern Africa: Key issues for strengthening women's access to and rights in land [Internet]. Rome, Italy; 2002. Available from: <http://www.jurisafrica.org/docs/statutes/Walker+on+Women%27s+access+to+Land.pdf>
  57. Tumlinson K, Thomas JC, Reynolds HW. The Effect of Women's Property Rights on HIV: A Search For Quantitative Evidence. *AIDS Care.* 2015;27(1):112–22. [PubMed: 25117719]
  58. Grabe S Promoting gender equality: The role of ideology, power, and control in the link between land ownership and violence in Nicaragua. *Anal Soc Issues Public Policy.* 2010;10(1):146–70.
  59. Henrysson E, Joireman SF. On the edge of the law: Women's property rights and dispute resolution in Kisii, Kenya. *Law Soc Rev.* 2009;43(1):39–60.
  60. Yngstrom I. Women, wives and land rights in Africa: Situating gender beyond the household in the debate over land policy and changing tenure systems. *Oxford Dev Stud.* 2002;30(1):21–40.
  61. Welch CJ, Duvvury N, Nicoletti E. Women's property rights as an AIDS response: Lessons from community interventions in Africa [Internet]. 2007. Available from: <https://www.icrw.org/publications/womens-property-rights-as-an-aids-response-lessons-from-community-interventions-in-africa/>
  62. Besley T Property Rights and Investment Incentives: Theory and Evidency from Ghana. *J Polit Econ.* 1995;103(5):903–37.
  63. Holden S, Yohannes H. Land redistribution, tenure insecurity, and intensity of production: A study of farm households in Southern Ethiopia. *Land Econ.* 2002;78(4):573–90.
  64. Owubah CE, Le Master DC, Bowker JM, Lee JG. Forest tenure systems and sustainable forest management: The case of Ghana. *Forest Ecology and Management.* 2001;149 (1-3): 253–264.
  65. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (v. 3). 2007. Washington, D.C., USA. Available from: <https://www.fantaproject.org/monitoring-and-evaluation/household-food-insecurity-access-scale-hfias>.

66. Perry B, Oluoch L, Agot K, Taylor J, Onyango J, Ouma L, Otieno C, Wong C, Corneli A. Widow cleansing and inheritance among the Luo in Kenya: The need for additional women-centered HIV prevention options. *Journal of the International AIDS Society*. 2014; 17:1–7.
67. Federation of International Women Lawyers in Kenya. 2021 Annual Report of the Federation of Women Lawyers in Kenya. 2021. Retrieved from: <https://www.fidakenya.org/ishypixi/2022/04/FIDA-Kenya-2021-Annual-Report-.pdf>



**Figure 1:** Proposed pathway of upstream and downstream factors associated with the effect of perceived land tenure on the *Shamba Maisha* multisectoral agricultural intervention to improve HIV health outcomes

**Table 1:**Socio-demographics and land access among 30 participants in the land-tenure *Shamba Maisha* sub-study

<i>Characteristics</i>	<i>Women (N[%] or median [IQR])</i>	<i>Men (N[%] or median [IQR])</i>
	<b>N = 15</b>	<b>N = 15</b>
<b><i>Sociodemographic variables</i></b>		
<i>Head of household</i>	8 (53.3%)	14 (93.3%)
<i>Married with single partner</i>	7 (46.7%)	10 (66.7%)
<i>Married with multiple partners</i>	1 (6.7%)	3 (20.0%)
<i>Widowed</i>	7 (46.7%)	1 (6.7%)
<i>Single</i>	0 (0%)	1 (6.7%)
<i>Living in peri-urban area</i>	6 (40.0%)	6 (40.0%)
<i>Living in rural area</i>	9 (60.0%)	9 (60.0%)
<i>Age</i>	46.0 (39.0, 53.0)	41.0 (36.0, 48.0)
<i>Age of children &lt;= 17 years old in household</i>	8.5 (5.0, 12.0)	9.0 (5.0, 12.5)
<i>Years on ART</i>	6.0 (2.0, 7.4)	4.6 (2.5, 6.9)
<i>2+ Children</i>	13 (86.7%)	14 (93.3%)
<b><i>Perceived Land Access</i></b> *		
<i>Land insecure</i>	5 (33.3%)	2 (13.3%)
<i>Land secure</i>	10 (66.7%)	13 (86.6%)
<b><i>Type of Land Access</i></b> *		
<i>Freehold (permanent ownership)</i>	9 (60.0%)	10 (66.7%)
<i>Has any written documentation about rights to land</i>	2 (13%)	5 (33.3%)
<i>Name appears on title</i>	1 (6.7%)	3 (20%)
<i>Customary (customary ownership)</i>	2 (13.3%)	0 (0%)
<i>Informally occupied</i>	4 (26.7%)	3 (20.0%)
<i>Rented or Leased</i>	0 (0%)	2 (13.3%)

\* 'Land Access' refers specifically to the type of land that study participants were using for the *Shamba Maisha* study and does not include additional pieces of land to which some participants may have had access. For the qualitative sub-study, land access typologies were created or determined based on coding of self-reported qualitative data derived from IDIs.

**Table 2:**Level of education among 30 participants in the land-tenure *Shamba Maisha* sub-study

<i>Highest level of education completed</i>	Women (N[%] or median [IQR])	Men (N[%] or median [IQR])
	N = 15	N = 15
<i>Some primary</i>	8 (53.3%)	1 (6.7%)
<i>Primary</i>	4 (26.7%)	6 (40.0%)
<i>Some secondary</i>	2 (13.3%)	1 (6.7%)
<i>Secondary</i>	0 (0.0%)	5 (33.3%)
<i>Some college</i>	0 (0.0%)	1 (6.7%)
<i>Diploma</i>	1 (6.7%)	1 (6.7%)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript