Working Title: Do Kids Eat Better when Moms have More Say on the Farm? Women's Access to Land Resources and Childhood Nutritional Status in the Semi-Arid Regions of Kenya

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Abstract of Paper (150 words)
Majority of smallholder farmers are women, yet men formally own majority of farmlands in sub-Saharan Africa. This study explores how women's access to land resources relates to their children's anthropometric growth status.
Children and mothers from 221 households were sampled from two counties in semi-arid Kenya. Access to land resources is defined as the power to benefit from food crops, cash crops, and decision-making participation on cultivated land. Significantly higher mean weight-for-height z-scores and weight-for-age z-scores of children were observed in households where women reported at least some participation in agricultural decisions compared with women who had very low participation. Gender of household head augments the mean differences of anthropometric scores. When adjusted with mother's education, age, and household wealth in multiple regression analysis, mothers who have higher participation on farm decisions remain associated with higher WHZ-scores in their children.

1.0 INTRODUCTION

1.1 Women Smallholders and Access to Land Resources in sub-Saharan Africa

Among the rural populations in sub-Saharan Africa, more than two thirds are considered smallholder farmers (Dixon *et al*., 2001; Dixon *et al*., 2004). Subsistent, smallholder farmers are the major producers of food in many developing countries (FAO, 2004; IFAD, 2011). They have diverse sources of livelihood besides rain-fed agriculture, such as herding livestock and working off-farm activities (Ellis, 2000; FAO, 2011). The term 'smallholder' refers to their limited resource endowments such as land, agricultural inputs, and access to markets and institutions. Hence, they are often restricted in their capacity to cope during times of stress such as shifting seasonal rainfall, extreme climate events, population pressure, and food price volatility.

Generally, women face more limitations than men in their access to productive factors, including land, technology and credit in developing areas (Agarwal, 1988, 1994a, 1994b; Besteman, 1995; Carney & Watts, 1991; Judith Carney, 1988; Gray & Kevane, 1999; Koopman, 2009). Over 70% of smallholder farmers in sub-Saharan Africa are women yet men formally own majority of farmlands in sub-Saharan Africa. Women are customarily entitled to secondary rights to cultivate the land of their husbands or fathers. Such access to land resources through kinship is tenuous in many patrilineal inheritance systems. In many cases, widows, divorcées, women who are in informal unions, or are never-married lose access to the land, making them more vulnerable to food insufficiency and mal-nutritional (Gray & Kevane, 1999). Studies on women's land rights have shown empirically that these critical entitlements are correlated with increased empowerment and better outcomes for women and children (Agarwal, 1994a, 1994b; Doss 2013; Frankenberger & Coyle, 1993).

Traditional means of accessing land resources in Kenya are shifting. Demographic trends such as increased, improved attendance of girls in school and decreased rate of marriage, single-motherhood, and grand-parents rearing grand-children in multigenerational increase pressure on addressing the importance of women's entitlements to land resources. Changes in formal and informal institutional processes, such as land privatization, customary inheritance, likewise have overarching impacts on women's access to land resources (FAO, 2011a).

1.2 Land Access and Childhood Nutritional Challenge in Kenya

In Kenya, an estimated average of 1.5 million people were projected to require humanitarian food assistance in 2015 (WFP 2015). The most recent 2008-09 Kenya Demographic and Health Surveys reported 35% of children under five were stunted, with stunting highest at 46% in children 18-23 months (KNBS 2009). An abundance of longitudinal and cross-sectional evidence from western high-income countries as well as developing countries had indicated that early stages of undernutrition in infants and children below 5 years drastically impair physical and cognitive growth of the persons in their life-course (Victoria *et al*. 2008). Not only does suboptimal cognitive growth in early childhood affect learning in primary and post-graduate education, but it also affects economic productivity, earnings, economic dividend from health in the population. There is little doubt the importance of reducing children undernutrition; the challenge is doing so with contextual considerations of extreme environmental constraints, historical context of colonization, rigid local institutions and vibrant customary norms around resource management. The conceptual framework used in this research attempts to view the challenge of improving childhood nutrition within a socio-ecological lens, incorporating theories of sustainable livelihoods, gender equity in access, and resilience science.

2.0 CONCEPTUAL FRAMEWORK

Conceptually, the research draws upon scholarship on sustainable livelihoods (Chambers, 1995; Scoones, 1998), access theory (Ribot and Peluso, 2003), and social-ecological resilience (Holling, 1973; Luthar, Cicchetti, & Becker, 2007; Walker *et al*, 2006, Bahadur, 2013). (Appendix Figure 1)

2.1 Sustainable Livelihoods Approach

The Sustainable Livelihoods Approach (SLA) aims to have a people-oriented development, recognizing the context-specific rural realities of the poor (Chambers, 1995; Scoones, 1998; Scoones, 2009). It emphasizes strengthening the set of capabilities and assets that already exist within households. The SLA has

five major categories for analysis. First, it places people within their *context*: shocks, stresses, seasonal trends which may weaken their livelihood outcomes or opportunities that may enhance their outcomes. Secondly, within the context, the people have different levels of *livelihood resources*, also known as the livelihood capital pentagon (DFID, 2000). The five capitals are: (1) natural capital, which includes land, water, soil fertility and other ecosystem services; (2) physical capital, which includes any built infrastructures and tools such as roads, buildings, plough, wells, irrigation system; (3) economic capital, which includes income, savings, credit, remittance; (4) human capital, which includes education, capabilities, health; and (5) social capital, which includes trust, membership and networks (Morse & McNamara, 2013). Thirdly this framework looks at how people exploit different capitals through formal and informal *institutional processes* and *organizational structures*, which North (1990) describes to be the rules of the game and its players, within livelihood strategies. Fourth, how people use their existing assets, or their *livelihood strategies*, are along the spectrums of agricultural intensification (e.g. increasing input of fertilizer and irrigation to a fixed plot size) and extensification (buying more land while using the same farming inputs per area); strategies for progressive or selective livelihood diversification (e.g. multiple sources of income during different seasons) (Turner, 2007), and specialization (e.g. becoming the best tomato growers in the region); and strategies that involve migration (e.g. to marginalized forest lands or to urban areas in search of wage or salary-based work) and their strategy portfolios over the long term (Morse & McNamara, 2012). Lastly, through these strategies, people achieve sustainable *livelihood outcomes* in terms of income, well-being, food security, nutritional health, as well as resilience to shocks and stresses while sustainably using their resource base.

SLA has been criticized to be less applicable in explaining how global processes such as globalization, food price volatility or climate change affect local-level livelihoods. Moreover, power relations, such as ethnic, class, gender relations, are not sufficiently emphasized in the framework (Michaud & Forsyth, 2011), which often assumes capitals within a household are similarly endowed across genders (Scoones, 2009). Livelihood capitals often lead to measurement of tangible livelihood outcomes in relations to economic productivities such as crop yield, labor, mean consumption per capita (de Haan and Zoomers, 2005). Other intangible outcomes from activities in leisure, culture, psychological and emotional support, reputation and trust are subsumed into social capital or regarded as having little significance with livelihood sustainability (Koning, 2002). To bolster the SLA, Theory of Access will complement by providing dimension of gendered power dynamics into the overall framework.

2.2 Theory of Access

Ribot and Peluso (2003), define "access" as the ability, akin to power, to benefit from resources. Beyond ownership of resources as "properties", "access" includes non-rights based, illicit, structural and relational, mechanisms to benefit from natural resources. Access analysis involves: 1) Identifying and mapping the flow of the benefits from land resources; 2) identifying the mechanisms by which different actors gain control, and maintain the benefit flow and its distribution; and 3) analyzing power relations underlying the mechanisms involved. These causal relations can be systematically traced out spatially and historically (Blaikie, 1985; Ribot, 1995; Vayda, 1983). In the present research, women's access to land resources is approached as a means to a set of livelihood outcomes within local and regional contexts and institutional processes. These rights-based and non-rights-based mechanisms are studied as a process by which access is gained, maintained, controlled and changed over time (Peluso, 1996; Ribot & Peluso, 2003).

2.3 Social-Ecological Resilience

The broad motivation for this research is to enhance the resilience of smallholder farming systems to household food insecurity. Social-ecological resilience has been defined as the capacity of a system to absorb disturbance and undergo change in a dynamic process to encompass positive adaptation to maintain its functions, structures, identities, and feedbacks (Holling, 1973; Luthar, Cicchetti, & Becker, 2007; Walker *et al*, 2006). Resilience within the social domain is "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change" (Adger, 2000:347). As smallholder farmers' livelihoods are closely dependent on their natural environment, framing our understanding of their livelihood dynamics and access mechanisms within a complex social-ecological system

will benefit from translational concepts of adaptability, transformability, panarchy, attractors and regime shifts (Walker *et al*. 2004; Walker *et al*. 2006). Combining this rich literature on social-ecological systems with access theories, explicit in asking social normative questions of power relations, cultural values and equity, will bolster the aim of understanding how local institutions and customary norms shape women's access to land resources and in turn, how such access affects childhood nutritional health at the household level.

3.0 RESEARCH AIM

Building on the sustainable livelihoods, theory of access, social-ecological resilience literature, my research aims to understand how female smallholder farmers navigate within a broad social-ecological system to access land resources and how this may affect household food security in the semi-arid midlands of Kenya.

Among the wealth of qualitative evidence, case studies in socio-anthropological and economic research, there is a lacuna of empirical evidence relating women's access to land resources to childhood growth, nutritional health as an important indicator of household food security in Kenya as well as other semi-arid agrarian societies. With the aim of providing empirical evidence to influence future gender equity and land resource use policies and interventions, we ask the question, "To what extent is there an association between access to land resources by female smallholder farmers and child nutritional status in the semi-arid midlands of Kenya?" We hypothesize that better access to land resources by female smallholder farmers will be associated with an improvement in childhood anthropometric measures in height-for-age, weight-for-height, and weight-for-age z-scores.

4.0 METHODS

4.1 Research Population and Setting: Ukambas in the Semi-Arid Midlands

There are 42 official ethnic groups in Kenya based on three major linguistic groups: Bantu, Nilotic, Cushtic peoples (Hodd, 1991). Kamba ethnic sub-group belongs to the Bantu people, which originate from the Niger-Congo language family region of the continent (Tiffen *et al.* 1994). Ukambas represent approximately 9.3% of Kenya's population, the fifth largest ethnic communities in Kenya. Oral history evidence implied that the earliest Ukambas settled in the area around the 17th century (Kaplan, 1984). Since then, Kambas have carried out polygamous and monogamous unions within patrilineal societies (Tiffen *et al.* 1994). High fertility rate and single motherhood, as well as the HIV/AIDS pandemic resulted in intergenerational family structures where grandmothers become the primary care-giver for their grand-children (Linsk & Mason, 2004; Nyambedha *et al.* 2003; Omariba, 2006). Many Kambas maintain associations with their clans, but my preliminary interviews in 2013 indicated that clan cohesion is gradually weakening in the Kamba culture. Predominant religious beliefs are Catholic and Protestant Christianity. Traditional beliefs of magic and fear of curses remain a part of Kamba society (Hobley, 2010).

Kamba smallholder farmers generally rely on subsistence production, combining food crop and livestock production under conditions of moderate land use intensity (Jaetzold *et al*., 2006; G. o. Kenya, 2003). These farmers grow a range of subsistence and cash crops such as maize, beans, pigeon peas, green grams, cassava, sweet potatoes, arrowroot, pumpkin, kale, nightshades, orange, tangerine, lemon, mango, avocado, papaya and banana and cotton (Jaetzold *et al*., 2006; observations 2013). Besides subsistence farming, many farmers engage in casual labor and non-farm activities such as basket and rope weaving, for a living (observations, 2013). These livelihoods are often supported by the collection of forest products such as firewood, charcoal, herbal medicine, honey, wild-edible food and traditional alcoholic brew (Kagio & Musembi, 2013).

The research is situated in Machakos and Makueni County. These counties are two of the three counties that comprise the Kambaland. Over 95% of the inhabitants belong to the Kamba ethnic community. Rainfall varies regionally, with total annual average range between 500 and 1300mm (Jaetzold *et al*., 2006). There is a 66% rainfall reliability during the growing period of the first rainy season <100-450 mm, and 80-530 mm in the second rainy season (ibid). The semi-arid lower midlands (LM) are situated within agro-ecological zones LM 4 and LM 5, where annual temperature ranged from 21-24 ^{o}C and yield is increasingly poor as zone number increases (ibid). There is a long and short rain season between March to May and October to December, respectively.

4.2 Data Sources

4.2.1 KEMRI Nutritional Data 2012

The KARI-McGill KEMRI Household survey was administered in 2012 (n=278) in Machakos and Makueni Counties (AEZ LM4 and LM5, 400-800 mm rainfall). Stratified randomized sampling was used to select the mother-child pairs. The household survey contained anthropometric measures of children under 36 months as well as relevant health measures of the mother (UNICEF, 2012; WHO & UNCEF, 2009). Weight measurements were obtained using lightweight bathroom-type scales with a digital screen designed and manufactured under the guidance of UNICEF (2012). Height measurements were carried out using a measuring board.

4.2.2 KARI Gender and Land Resource Data 2014

Primary data were collected from a follow-up visit after two years of the same sample of women-child pairs (n=278) in 2014 to learn more about the mothers' level of access to land resources. Attrition rate due to death and migration was less than 10%, resulting in a sample of 252 women-child pairs in our sample. A supplementary community questionnaire was designed to capture community-level data. Village elders participated in community questionnaires in each village (n=125) where a mother and child were sampled, providing community-level data for multi-level analysis.

Survey questions included indicators of land resource access, intra-household decision-making over land resources, land tenure, farm labor, selling of crops and livestock, as well as indicators of social capital adapted from the Indian Human Development Survey (IHDS 2004): group memberships, civic engagement, community reciprocity, local trust, confidence in institutions, community assistance and self-perception of general well-being.

4.3.3 Qualitative Data 2013-2014

There were 77 in-depth interviews, 16 focus-group discussions, and 7 community meetings held in Makueni County. In-depth interviewees include smallholder farmers, local village elders, chiefs, district agricultural and land bureau officers. Discussion and interviews followed a semi-structured interview guide. Questions evolved as the researcher progressively built a more nuanced, in-depth understanding of the research topic (Creswell, 2007; Strauss & Corbin, 1990; Small, 2009). Meetings and interviews included discussions on broader livelihood strategies, challenges in access to land resources, who used and benefited from the land resources. Also questions were asked about what roles respondents performed in the family and community, experienced with group access to land resources, experienced with family land inheritance, and decision-making for land purchases and inheritance, attitudes to the constitution versus customary laws (Rubin & Rubin, 2005). Interviewees were selected through snowball sampling. Interviews were approximately 90 minutes in duration conducted with an interpreter. Audio recordings of interviews were transcribed into Kikamba, the local language, and translated from Kikamba to English by local Kambas. Kikamba transcripts were read following audio recordings to ensure completeness in transcripts. Validation was done by selecting samples that were transcribed and translated by a second transcriber and compared. These transcription, translation, and validation methods serve to minimize loss of data. English transcripts were used for deductive and open coding analysis using RQDA.

4.3 Indicators

Outcome variables are anthropometric indicators that identify departures of height and weight from the median at a given age and sex in a well-nourished population. These are continuous variables of height-for-age z-score (HAZ), weight-for-height z-score (WHZ), and weight-for-age z-score (WAZ) in children ≤36 months old. These scores are standardized by age and gender using a reference new growth standards for 0 to 5 year olds based on the Multi-Centre Growth Reference Study (WHO 2006). These standardized scores are centered around zero mean. Children with scores measured below -2 of the z-scores are defined as suffering from stunting (HAZ<-2), wasting (WHZ<-2), and underweight (WAZ<-2). Considering intervening factors

such as genetic variation, anthropometry is a feasible physical measurement to assess the early childhood growth based on nutrient intake, particularly in infants and children.

Explanatory categorical variables of interest are "mother's participation in farm decisions" based on responses from 7 questions on common farm activities such as "In the past season, who decided to: "buy specific seeds", "prepare the lands", "start weeding", "spray chemicals", "apply manure", "plant trees", "build terraces". Mother's participation is counted if she reported being one of the many or sole participant in decision-making process. In cases where the respondent did not report participating in decisions made on the activity, but a woman, such as her mother-in-law or sister-in-law, was reported, then it was counted in "decisions made by any woman in household". For example, "husband", "mother-in-law" was reported having decided on apply manure, the case would not be counted in the variable "mother's participation in farm decision", but counted in "decisions made by any woman in household". The variable used for analysis is categorical variable of no participation in any farm decisions and participation in at least one farm decision. For sensitivity test, a second categorical variable is created for "low" participation in farm decisions and "high" level of participation. "Level of sole decision-making by mother on land resources" is a binary variable based on composite score of 4 questions asking whether the respondent "can alone decide to" "grow fruit trees on the farm" "put up a fence if desired" "sell the harvest from the farm" "sell the farm". Other land tenure related variables are: "women with formal land ownership", "gender of household head", "who the land was acquired from". Socio-demographic variables include "mother's body mass index (kg/m^2)", "mother's highest level of education", "household connected with electricity", and "household asset index".

"Household asset index" is an index generated relative to the sample from Principal Component Analysis (Filmer & Pritchette, 2001) using household consumer products such as television, solar panel, vehicle) and dwelling structures as proxies: such as materials used for roof, floor, latrine type.

4.4 Statistical Analysis

This research study uses mixed-methods approach in conceptualization, survey design, data collection, and analysis. After merging and cleaning the KEMRI Nutritional Data 2012 and KARI Gender and Land Data 2014, a sample size of n=221 households form the basis of our statistical analysis using STATA.

Descriptive analysis used bar graphs to show possible trends and patterns in association of childhood nutritional status and land access indicators.

Statistical difference in mean z-scores of (i) height-for-age were tests across (1) mother's participation in farm decisions—almost no participation vs. at least some participation, (2) mother's low vs. high participation in farm decisions, (3) fewer or more farm decisions made by any woman in the household, and (4) high or low level of sole decision-making on land resources. These *t*-tests were repeated for outcome variables (ii) weight-for-height, (iii) weight-for-age. The *t*-tests were used to detect differences in mean z-scores when sample was stratified by gender of household heads.

The cross-sectional data was analyzed using Ordinary Least Squares regressions adjusting for heteroscedasticity in small sample data. The dependent variable, child nutritional status, Y, is hypothesized to be determined by K explanatory variables, denoted as X and indexed as k=1…K, Z denote explanatory variables for interaction terms, and random error ε. The basic model takes the form:

$$Y = \beta_0 + \sum \beta_k X_k + \sum \beta_k X_k * Z_k + \varepsilon.$$

Outcomes of height-for-age, weight-for-height, weight-for-age z-scores are associated separately with female access to land resources, intra-household decision-making and other socio-demographic variables, in the regression models. Interactions terms of factors with socio-demographic variables such as education and age would be included in the regression models.

For example, regression model looking at the outcome of weight-for-height z-scores with explanatory variable of mother's participation in farm decisions, while controlling for mother's education, mother's BMI, mother's age and household asset index would be:

$$WHZ = \beta_0 + \beta1*decision\_participation + \beta2*primary\_education + \beta3*above\_primary + \beta4*underweight + \beta5*overweight + \beta6*mom\_age\_cat1 + \beta7*mom\_age\_cat2 + \beta8*mom\_age\_cat3 + \beta9*asset\_ter1 + \beta10*asset\_ter2 + \varepsilon$$

Model (1): $WHZ = \beta_0 + \beta1*decision\_participation + \beta2*primary\_education + \beta3*above\_primary + \beta4*mom\_age\_cat1 + \beta5*mom\_age\_cat2 + \beta6*mom\_age\_cat3 + \beta7*asset\_ter1 + \beta8*asset\_ter2 + \varepsilon$

Model (2): $WHZ = \beta_0 + \beta1*decision\_participation + \beta2*primary\_education + \beta3*above\_primary + \beta4*underweight + \beta5*overweight + \beta6*mom\_age\_cat1 + \beta7*mom\_age\_cat2 + \beta8*mom\_age\_cat3 + \beta9*asset\_ter1 + \beta10*asset\_ter2 + \varepsilon$

Model (3): $WHZ = \beta_0 + \beta1*decision\_participation + \beta2*primary\_education + \beta3*above\_primary + \beta4*mom\_age\_cat1 + \beta5*mom\_age\_cat2 + \beta6*mom\_age\_cat3 + \beta7*asset\_ter1 + \beta8*asset\_ter2 + \varepsilon$
If houeshold_head = man

Model (4): $WHZ = \beta_0 + \beta1*decision\_participation + \beta2*primary\_education + \beta3*above\_primary + \beta4*underweight + \beta5*overweight + \beta6*mom\_age\_cat1 + \beta7*mom\_age\_cat2 + \beta8*mom\_age\_cat3 + \beta9*asset\_ter1 + \beta10*asset\_ter2 + \varepsilon$
If houeshold_head = man

Model (5): $WHZ = \beta_0 + \beta1*women\_participation + \beta2*primary\_education + \beta3*above\_primary + \beta4*mom\_age\_cat1 + \beta5*mom\_age\_cat2 + \beta6*mom\_age\_cat3 + \beta7*asset\_ter1 + \beta8*asset\_ter2 + \varepsilon$

Model (6): $WHZ = \beta_0 + \beta1*$ *women _participation* $+ \beta2*primary\_education + \beta3*above\_primary + \beta4*underweight + \beta5*overweight + \beta6*mom\_age\_cat1 + \beta7*mom\_age\_cat2 + \beta8*mom\_age\_cat3 + \beta9*asset\_ter1 + \beta10*asset\_ter2 + \varepsilon$

Model (7): $WHZ = \beta_0 + \beta1*$ *women _participation* $+ \beta2*primary\_education + \beta3*above\_primary + \beta4*mom\_age\_cat1 + \beta5*mom\_age\_cat2 + \beta6*mom\_age\_cat3 + \beta7*asset\_ter1 + \beta8*asset\_ter2 + \varepsilon$
If houeshold_head = man

Model (8): $WHZ = \beta_0 + \beta1*$ *women _participation* $+ \beta2*primary\_education + \beta3*above\_primary + \beta4*underweight + \beta5*overweight + \beta6*mom\_age\_cat1 + \beta7*mom\_age\_cat2 + \beta8*mom\_age\_cat3 + \beta9*asset\_ter1 + \beta10*asset\_ter2 + \varepsilon$
If houeshold_head = man

Models (9) to (16) in Appendix Table 1 and 2 are the same regression models replacing outcome WHZ with WAZ.

5.0 RESULTS

5.1 Descriptive Results

36% of mothers do not participate in decisions on farm activities

Table 1 presents the descriptive results from our sample of 221 mother-child pairs. 36% of mothers reported having almost no participation in decisions on common farm activities. 30% of the households reported that more than three of the seven common farm decisions are made by a woman in the household. 97% of all mothers interviewed reported having no formal land ownership. Corroborating previous research findings, literacy is not the major barrier to access, as 78% of mothers completed at least primary school. In our sample, 15% mothers were underweight (BMI < 18.5 kg/m^2) and 18% of them are overweight (BMI > 25 km/m^2). Of the children from these households, 23% suffered from stunting, 10% suffered from wasting, 27% suffered from underweight (Table 1).

Bar graphs illustrated lowered prevalence of children stunting and wasting where their mothers reported higher level of sole decision-making regarding land resources. Interestingly in women-headed households, prevalence of stunting and underweight increases when women reported higher level of sole decision-making (Figure 1). This suggested that gender of household head may be proxy for an effect modifier for association of land resource access and childhood nutrition. We explore this in the next analyses.

5.2 Difference in means, *t*-tests

Women participating in farm decisions is associated with higher mean nutritional scores in children

Table 2 presents independent-samples *t*-test results. HAZ, WHZ, and WAZ mean scores were compared by participation in farm decisions, farm decisions made by any woman, level of sole decision-making on land resources.

An independent-samples *t*-test was conducted to compare HAZ, WHZ, and WAZ mean scores of children from households with high level of mother's participation in farm decisions and low participation. There was a significant difference in the mean WHZ from households with higher level of participation in farm decisions (μ=-0.22, SD=1.08) and lower level of participation (μ=-0.48, SD=1.30); t(219)=-1.50, p=0.13.

Moreover, we observed augmented differences in men-headed households only (n=188). Mean children's WHZ is associated with mothers reported higher level of participation on farm decisions (μ=-0.12, SD=1.04) than lower level of participation (μ=-0.50, SD=1.33); t(186)=-1.89, p=0.06 and similarly in mean children's WAZ (p=0.07). This effect modification by gender of household head elucidates some of the complexities around gender and land resource access discussed in the next section.

When asked whether these decisions related to farm activities were made by at least one woman in the household, regardless whether she is the mother of the child, there was a significant difference in the mean children's WHZ from households with more farm decisions made by women (μ=-0.12, SD=1.33) and fewer decisions (μ=-0.52, SD=1.19); t(219)=-2.22, p=0.03. There was also a significant difference in the mean children's WAZ from households with more farm decisions made by women (μ=-1.07, SD=1.45) and fewer decisions (μ=-1.37, SD=1.12); t(219)=-1.64, p=0.10. Again, we observed augmented differences of mean WHZ when stratified by gender of household for more farm decisions made by women (μ=0.05, SD=1.42) and fewer decisions (μ=-0.50, SD=1.19); t(186)=-2.50, p=0.01and similar in WAZ (p=0.01) (Table 2).

The statistically significant differences in mean z-scores consistently support the hypothesis that decision-making involvement by the mother or any woman, often by a more senior woman in the family hierarchy, is associated with higher mean z-scores of weight for height, weight for age, but not height for age of children in the households.

5.3 OLS Regressions

Even a little participation in farm decisions is associated with higher WHZ

Table 3 presents OLS regressions of Models (1) to (4).

Table 4 presents OLS regressions of Models (5) to (8).

Household wealth and mother's characteristics have major influences on their children's growth. To test whether the differences in children's WHZ and WAZ observed by *t*-tests were robust when controlling for other important socio-demographic variables, we conducted multiple regressions. Mother's education and mother's body mass index are important factors to early stage childhood growth and nutritional status. Yet our regression analyses showed that even some participation on the mother's part in farm decisions attribute significantly to the children's WHZ. Adjusting for mother's education, age, and household wealth, mothers who reported at least some participation in farm decisions are associated with children who have on average a 0.30 standard deviation higher WHZ (beta=0.30 p=0.16). When we adjusted further with the mother's BMI, the association attenuated (Table 3, 4). As expected, mother's being overweight is significantly associated with higher children's WHZ (Table 3, 4) and WAZ (Appendix Table 1, 2). Interestingly, household wealth does not have significant influence on childhood anthropometric measures in our sample (p>0.20). We purport that indicators of women empowerment in the household may be more salient indicators and predictors of childhood nutritional growth and household food security than socio-economic variables such as household asset index.

6.0 DISCUSSION

This study had three major findings:(1) 36% of women farmers below 45 years old reported having extremely low participation in decisions related to farm activities. (2) Women participating in farm decisions are associated with children having higher mean weight-for-height and weight-for-age z-scores. (3) When accounting for mother's education and BMI, women's participation in farm decisions compared to almost no participation remains as an important predictor of children's weight-for-height growth. In this section, we discuss how these findings add to our understanding of the challenges in improving childhood nutrition health through gender equity within a socio-cultural context.

In Kambaland, it is customary and expected that young mothers with small children cultivate food to feed her children on the piece of land given to the husband. Some of the youngest wives also cook for their mother-in-laws and tend their farms if they live under one roof. To my knowledge, all the women interviewed work as smallholder farmers as their main way of living. In the rural settings, community-centric approaches to forming livelihood strategies remain preferable; that is, individuals will prioritize choices favorable for the

family over choices favorable for themselves. Within this context, a young mother will be living in an extended family with her husband, parents-in-law and brother-in-laws' families as neighbors. Generally, decisions are made by the most senior member in the family household. Even if the husband works away from the farm, it is general practice for the wife to ask for permission before she goes ahead with farm activities. Also, there are traditional beliefs on gender role associated to specific farming tasks. Some shared that traditionally men are responsible for tilling the land with the ox and plow, but in the field, I observed plenty of women who worked manually with a hoe to till the soil. Community meetings and focus group discussions revealed that traditionally, women weed, manage tree nurseries, harvest crops, and keep poultry. Men "stay away" from these tasks. Yet, many women and men reported both men and women participate in farm management if they desire a good yield for that season.

Women's role as workers, managers, protectors of the farm is evident, yet we find more than 35% of these young mothers reported having no participation in the decisions around seven common farm activities. Decision-making within the household can be in the form of giving permission, being consulted for certain activities. It allows the decision-maker to control how much users benefit from the land resources. One explanation in the low involvement of decision-making by women is that many of the decisions involve financial resources such as purchase of seeds, pesticides, hire laborers to dig terraces. When women are asking for permission, they are in another sense asking for the monetary means to carry out the desired task. Two of the activities "buying seeds" and "spray chemicals" often require certain amount of disposable cash which the mothers may not have. A 2 kg pack of maize cost around 200 to 300 KES (2.5 to 4.0 USD) at the local agro-vet supply store. The member who controls the expendable financial resources in the form of cash, credit, stored harvest, livestock, acts as a gatekeeper and decision-maker around farm activities. Women's access to the land resources through financial capital is limited to a very small scale: trading a handful of maize at the market to buy small quantity of oil, salt, personal items, without the need to ask for permission, or selling a chicken if necessary to gain a larger sum. Another explanation that is often mentioned in men-only focus-groups is that women lack specific agricultural knowledge. "They do not know the different soil types," one man said. "They do not know the right dosage for fertilizers or pesticides." A third explanation that applies to both men and women farmers is the lack of land tenure security. Decisions to "plant trees" in the farm plot signals a more permanent investment in the farm. Planting trees is beneficial in reducing soil erosion on the farm, as well as harvesting fruits from fruit trees. Often recently married couples would be shown a piece of land to cultivate, yet this piece of land would still belong to the father. In the event of a subdivision of his land to his sons, the young couple may be allocated to another section of the plot to make room for another brother. These are one of the uncertainties that prevent farmers who are shown their land to plant trees. A young mother I interviewed said that the village elders advised her to plant pawpaw (Kikamba for papaya) trees for the children's sake because even if there is no food (maize as a staple food) in the field during an unfavorable season, the children will still have fruits to eat. The trees grow quickly and can bear fruits in two to three years.

When we exam mother's access to land resources, the data indicates that grandmothers, in relation to the child of interest in this study, have acquired improved access to land resources through increased involvement in household and farm decisions. After grandfather passes, a grandmother rises in stature within the family and takes on the role of household head. The seniority and respect the grandmother has within the household and the community, is a result of time. During which, if the woman built her social networks, participated community groups such as clan committees, church committees, women self-help groups, chief's meetings and crowd-fundraising events, she accumulated her social capital. Community involvement not only increases the woman's exposure to new information, opportunities to reciprocate within the community, and mobilize human resources when needed, it also allows the woman to gain trust from family members, neighbors, and authority in the community. The data suggest that grand-mothers utilize their social capital to have better decision-making control within the family, in turn translating that livelihood asset to better nutritional status within the family for young children.

These differences in mean anthropometric measures are greater when we stratified men-headed households and women-headed households. Literature on resource poor regions has shown strong evidence that women-headed households are more vulnerable due to lower access to livelihood resources such as

household income, credit, labor, and markets. In my interview with a widows group, many women lamented the loss of a husband is losing a partner to share farm labor, and possible external income for the family. This adds an important nuance to gender equity and land resource access. Customary norms dictate that widows are entitled to the control of husband's land. The chances of this being realized increases if the widow is a surviving grand-mother with authority and support from the community. The chances are much slimmer for young widows with young children, who are often reported being chased away by husband's relatives. Single mothers who are not married have user rights to a piece of her natal family's land, given permission by her father or brothers. This suggests that women-headed households have decision-making power and can make decisions on their own, not by choice or cooperation with male counterparts, but by disempowered circumstances. The negative effects on childhood's nutrition attributed reduced labour and household income from their loss of a husband overwhelm the positive impact on women's gained opportunities to make decisions. Hence, empirical impact on children's nutrition though women's participation in decision-making is more salient when we look at men-headed households only.

The anthropometric results from *t*-tests consistently supports our hypothesis that better access to land resources by women smallholder farmers is associated with an improvement in childhood anthropometric measures except for height-for-age and stunting. Nationally, Kenya has a 30% prevalence of children under five suffering from stunting, and even higher prevalence in the semi-arid rural areas. Height-for-age reflects cumulative linear growth and indicates past inadequate nutrition or chronic illnesses. As such, it is mainly used as a population indicator rather than for individual monitoring. On the other hand, weight-for-height is used as an indicator to screen individual children at risk of short-term nutrition inadequacy, resulting in wasting. Weight-for-age is a composite indicator combining HAZ and WHZ. This indicator is harder to interpret as it has components of long-term and short-term inadequacies, but it is also used in the Millennium Development Goals to reduce child malnutrition. In this sense, our results may not capture the long-term impact of women participation in decision-making in the last season. It would be interesting to further explore the associations of stunting prevalence with community level data on social cooperation and cohesion.

Ample evidence in social and biological sciences support the improving mother's education and BMI improves children's nutritional growth. Furthermore, *in utero* exposure to diet has been shown to affect children's long-term physical growth and cognitive development. Our analysis showed that mothers completing primary education is consistently associated with increased mean weight-for-height and weight-for age measures. The correlation of mother's education and mother's farm decision participation is r=0.08. The correlation of mother's BMI and her farm decision participation is r=0.22. This correlation is significant as mothers who are measured overweight, assuming due to nutrient intake, may exhibit more control over foodstuff within the household. This same access to food as a form of power to benefit from food either grown in her farm or bought at the market, may also indicate higher access to land resources through decision-participation. Beyond biological influence, a mother with high BMI has protective effect on the fetus during pregnancy. There may be social influences outside the womb, where mothers who have higher BMI are more well fed, well treated within the family, and are also making more decisions on household and farm resources. Indirectly, a mother with higher BMI is associated with better nutritional status of her children.

Our multiple regression analysis suggests that even while controlling for mother's education, BMI, mother's age, and household wealth, participation in farm decisions is a robust factor contributing to children's nutritional growth. Although statistical significance from *t*-tests diminishes when accounting for education and BMI, we argue that mothers having more say in farm activities will contribute to better child's growth in early years. Since 2003, education in Kenya's public primary schools became free and compulsory. In our sample, 77% of the mothers completed at least primary education, yet undernutrition is not improving in the rural areas at a proportional scale. Moreover, 69% of mothers who completed primary or higher education reported low or almost no participation in farm decisions. This evidence purport that by encouraging women to participate in cooperation with their male counterpart in decision-making on the farm, this effort may tap into an underutilized driver of improving childhood nutrition.

Would increasing awareness of these findings to mothers empower them? Would it give them reason to participate or even demand a say? Would explaining these findings to fathers motivate them to lead a mutual decision-making process on the farm for the nutritional benefits, cognitive development, and future

productivity of their children? Answers to these questions allow us to bridge the gap between scientific evidence and the daily lives of smallholder farmers who are embedded in a complex context of cultural and gender norms, household power relations and dynamics around land resources.

6.1 Limitations

When interpreting the results from this study, readers must keep in mind the study's limitations. The sample of this study of 221 mother-child pairs is relative small to detect strong associations and is not nationally representative. It has high homogeneity in ethnicity and low variability of tenure system. There is endogeneity within the association found between women's land resource access and childhood nutritional status since it is a cross-sectional dataset. Measuring children ≤36 months old makes direct comparison difficult with statistics of children ≤60 months old from other demographic and health surveys. Furthermore, the KARI gender and land survey assumes that the answers on intra-household decision-making and social capital reflect the state of these factors in 2012 when the KEMRI survey was administered to the same mothers.

Systematic bias and recall bias would be present when participants had an incentive to withhold what they really thought or to give answers that they thought were more socially, morally acceptable or what the enumerators wanted to hear. It should be noted that this study has primarily been an exploration of local institutions and norms around women's access to land resources. However exploratory, the observations do suggest that women's participation in decision-making on the farm may benefit children's nutritional growth in early years. Family structure, education level, exposure to technology, land fragmentation and population growth are some of the major factors that will catalyze a change in perceptions on women's access to land resources.

6.2 Future Directions

Based on our understanding of the local institutions around access to land in Kambaland, an important next step is better understanding the different types of access mechanisms women have strategically employed within their social-ecological system to improve their access to land. As mentioned briefly above, in order to better benefit from ones land resources, there needs to be not only rights-based access to land, but also access to capital, technology and market. These mechanisms of access through labor, knowledge, negotiation in the process of decision-making, may operate through social relations and social identity, and even illicit mechanisms of access. Our understanding of how some mechanisms can benefit short-term needs but jeopardize long-term sustainable access and the behaviors that result will facilitate design of long-term livelihood strategies by smallholder farmers.

By understanding who benefits, who decides, who restricts and how, we can better map out pathways of access to land resources that both aligns with customary values, formal policies, and learn innovative ways of access to land resources that enhance resilience within a rapidly changing social-ecological system.

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Figure 1. Bar Graphs on Level of Participation in Decision-Making and Childhood Nutritional Status

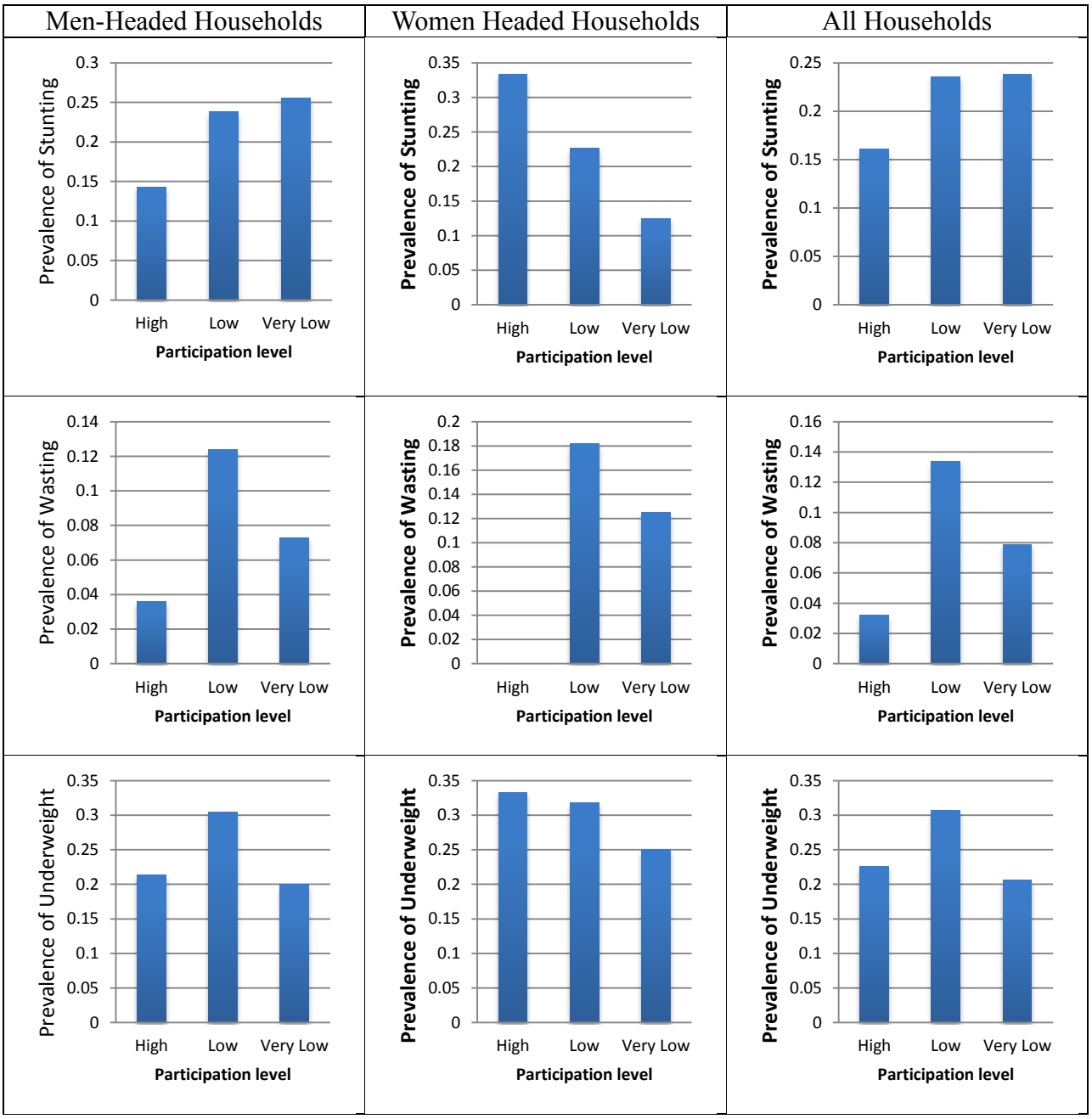


Table 1. Descriptive Statistics on Women's Access, Anthropometry and Socio-demographic Indicators

	n = 221	Percentage
Participation in Farm Decisions		
High	68	30.8
Low	74	33.5
Very Low	79	35.8
Farm Decisions made by Any Women		
Many Decisions	66	29.9
Few Decisions	155	70.1
Level of Sole Decision-making on Land Resources		
High	31	14.0
Low	127	57.5
Very Low	63	28.5
Women with Formal Land Ownership		
Yes	6	2.7
No	215	97.3
Household Headed by		
Men	188	85.1
Women	33	14.9
Land Acquired from		
Men Household Head	162	73.3
Women Household Head	38	17.2
Bought	16	7.2
Government	5	2.3
Childhood Anthropometric Status		
Normal HAZ-score	171	77.4
Stunted	50	22.6
Normal WHZ-score	198	89.6
Wasted	23	10.4
Normal WAZ-score	162	73.3
Underweight	59	26.7
Mother's Age (years)		
15-29	62	28.1
30-39	97	43.9
40-49	36	16.3
50 and above	26	11.8
Mother's BMI		
Underweight	33	14.9
Normal	148	67.0
Overweight	40	18.1
Mother's Education		
Below Primary	49	22.2
Completed Primary (Standard 8)	92	41.6
Above Primary	80	36.2
Household Asset Index		
Highest Tertile	65	29.4
Middle Tertile	59	26.7
Lowest Tertile	70	31.7
Electricity		
Yes	2	0.9
No	219	99.1

Table 2. Independent *t*-tests Comparing Mean Anthropometry Scores with Indicators of Participation

	HAZ-score			WHZ-score			WAZ-score		
	n	Mean	p	Mean	p		Mean	p	
Participation in Farm Decisions									
All Households	221								
Almost None	79	-1.19		-0.55			-1.44		
At Least Some Participation	142	-1.14	0.75	-0.32	0.19		-1.19	0.14	
Stratified by Gender									
Men Headed Households	188								
Almost None	67	-1.17		-0.58			-1.44		
At Least Some Participation	121	-1.13	0.81	-0.28	0.12		-1.13	0.09	*
Women Headed Households	33								
Almost None	12	-1.30		-0.40			-1.46		
At Least Some Participation	21	-1.20	0.81	-0.60	0.64		-1.53	0.87	
Participation in Farm Decisions									
All Households	221								
Low	153	-1.16		-0.49			-1.34		
High	68	-1.14	0.93	-0.22	0.13		-1.15	0.29	
Stratified by Gender									
Men Headed Households	188								
Low	132	-1.18		-0.50			-1.35		
High	56	-1.14	0.53	-0.12	0.06	*	-0.99	0.07	*
Women Headed Households	33								
Low	21	-1.05		-0.44			-1.29		
High	12	-1.55	0.23	-0.68	0.57		-1.88	0.23	
Farm Decisions made by Any Woman									
All Households	221								
Fewer Decisions	155	-1.15		-0.52			-1.37		
More Decisions	66	-1.16	0.96	-0.12	0.03	**	-1.07	0.10	*
Stratified by Gender									
Men Headed Households	188								
Fewer Decisions	147	-1.18		-0.50			-1.37		
More Decisions	41	-1.10	0.44	0.05	0.01	***	-0.79	0.01	***
Women Headed Households	33								
Fewer Decisions	8	-0.72		-0.92			-1.40		
More Decisions	25	-1.40	0.15	-0.40	0.26		-1.54	0.80	
Level of Sole Decision-making on Land Resources									
All Households	221								
Very Low Access	63	-1.06		-0.48			-1.29		
Some Access	158	-1.19	0.45	-0.37	0.54		-1.28	0.98	
Stratified by Gender									
Men Headed Households	188								
Very Low Access	55	-1.04		-0.48			-1.25		
Some Access	133	-1.18	0.45	-0.34	0.52		-1.24	0.95	
Women Headed Households	33								
Very Low Access	8	-1.21		-0.55			-1.53		
Some Access	25	-1.24	0.94	-0.52	0.95		-1.50	0.96	

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 3. Association of Child Weight-for-Height and Mother's Participation in Farm Decisions

	All Households n=194				Men Headed Households Subset n=163			
OLS Regression	(1)		(2)		(3)		(4)	
	β	p	β	p	β	p	β	p
Participation in Farm Decisions								
Almost None	1.00		1.00		1.00		1.00	
At Least Some Participation	0.20	0.30	0.17	0.38	0.30	0.16 ^	0.27	0.24
Mother's Education								
Below Primary	1.00		1.00		1.00		1.00	
Completed Primary (Standard 8)	0.33	0.13 ^	0.32	0.15 ^	0.37	0.15 ^	0.37	0.16 ^
Above Primary	0.10	0.69	0.05	0.86	0.20	0.47	0.17	0.55
Mother's BMI								
Normal	--	--	1.00		--	--	1.00	
Underweight	--	--	-0.26	0.29	--	--	-0.20	0.48
Overweight	--	--	0.40	0.07 *	--	--	0.49	0.03 **
Socio-demographic Variables								
Mother's Age in years	✓	✓	✓	✓	✓	✓	✓	✓
Household Asset Index	✓	✓	✓	✓	✓	✓	✓	✓

^ p<0.20, * p<0.10, ** p<0.05

Models (1) and (3) do not include mother's BMI

Table 4. Association of Child Weight-for-Height and Any Woman's Participation in Farm Decisions

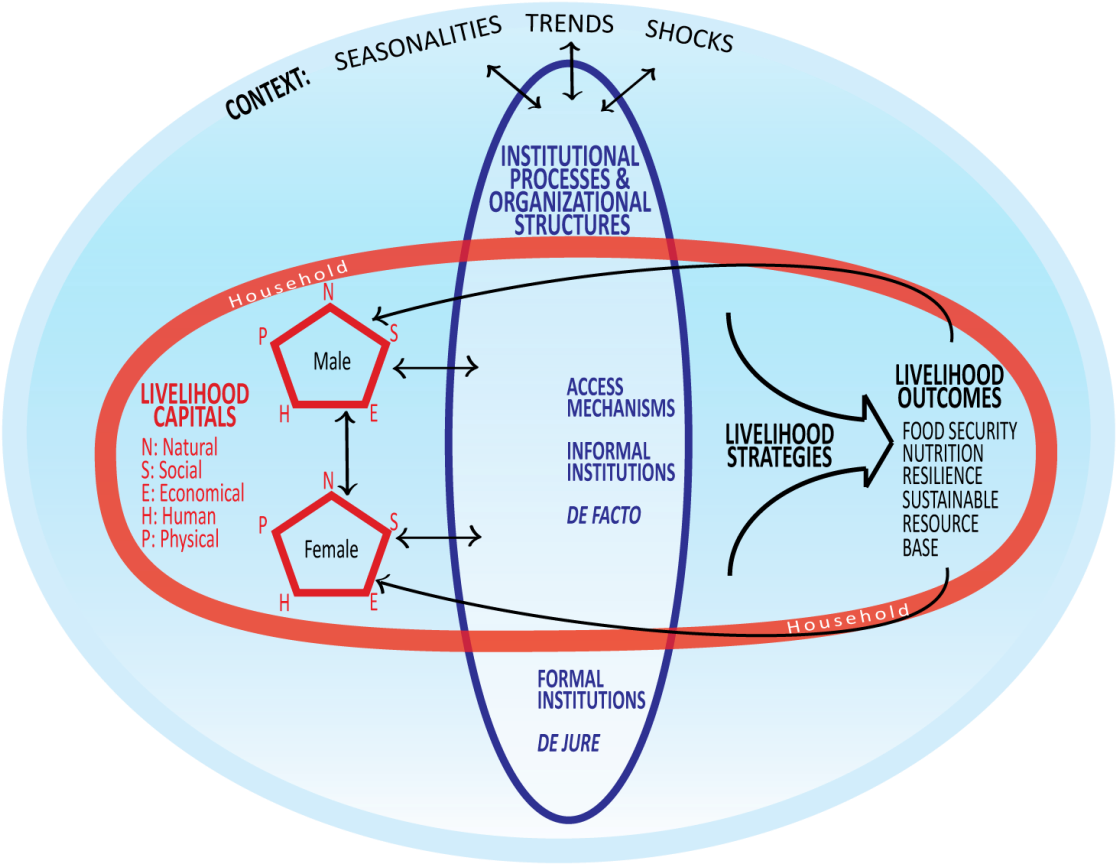
	All Households n=194				Men Headed Households Subset n=163			
OLS Regression	(5)		(6)		(7)		(8)	
	β	p	β	p	β	p	β	p
Farm Decisions made by Any Woman								
Fewer Decisions	1.00		1.00		1.00		1.00	
More Decisions	0.13	0.49	0.08	0.68	0.18	0.47	0.06	0.83
Mother's Education								
Below Primary	1.00		1.00		1.00		1.00	
Completed Primary (Standard 8)	0.33	0.13 ^	0.32	0.15 ^	0.38	0.15 ^	0.38	0.16 ^
Above Primary	0.09	0.72	0.04	0.88	0.20	0.49	0.18	0.54
Mother's BMI								
Normal	--	--	1.00		--	--	1.00	
Underweight	--	--	-0.28	0.25	--	--	-0.26	0.34
Overweight	--	--	0.40	0.08 *	--	--	0.48	0.05 **
Socio-demographic Variables								
Mother's Age in years	✓	✓	✓	✓	✓	✓	✓	✓
Household Asset Index	✓	✓	✓	✓	✓	✓	✓	✓

^ p<0.20, ** p<0.10, *** p<0.05

Models (5) and (7) do not include mother's BMI

Appendix

Figure 1. Conceptual Framework Adapted from SLF, Theory of Access



Appendix

Table 1. OLS Regression on Association of Mother's Participation in Farm Decisions and WAZ

	All Households n=194				Men Headed Households Subset n=163			
OLS Regression	(9)		(10)		(11)		(12)	
	β	p	β	p	β	p	β	p
Participation in Farm Decisions								
Almost None	1.00		1.00		1.00		1.00	
At Least Some Participation	0.16	0.37	0.14	0.45	0.20	0.31	0.17	0.41
Mother's Education								
Below Primary	1.00		1.00		1.00		1.00	
Completed Primary (Standard 8)	0.35	0.11 ^	0.34	0.12 ^	0.52	0.02 **	0.51	0.02 **
Above Primary	0.30	0.20	0.27	0.27	0.48	0.06 *	0.45	0.08 *
Mother's BMI								
Normal	--	--	1.00		--	--	1.00	
Underweight	--	--	-0.15	0.56	--	--	-0.18	0.50
Overweight	--	--	0.45	0.04 **	--	--	0.49	0.08 *
Socio-demographic Controls								
Mother's Age in years	✓	✓	✓	✓	✓	✓	✓	✓
Household Asset Index	✓	✓	✓	✓	✓	✓	✓	✓

^ p<0.20, * p<0.10, ** p<0.05

Models (9) and (11) do not include Mother's BMI

Appendix

Table 2. OLS Regression on Association of Women's Participation in Farm Decisions and WAZ

	All Households n=194				Men Headed Households Subset n=163			
OLS Regression	(13)		(14)		(15)		(16)	
	β	p	β	p	β	p	β	p
Farm Decisions made by Any Woman								
Fewer Decisions	1.00		1.00		1.00		1.00	
More Decisions	0.00	0.98	-0.05	0.80	0.23	0.35	0.12	0.64
Mother's Education								
Below Primary	1.00		1.00		1.00		1.00	
Completed Primary (Standard 8)	0.35	0.11 ^	0.34	0.12 ^	0.52	0.02 **	0.51	0.02 **
Above Primary	0.30	0.21	0.26	0.27	0.46	0.07 *	0.45	0.08 *
Mother's BMI								
Normal	--	--	1.00		--	--	1.00	
Underweight	--	--	-0.17	0.51	--	--	-0.21	0.43
Overweight	--	--	0.46	0.04 **	--	--	0.46	0.03 **
Socio-demographic Controls								
Mother's Age in years	✓	✓	✓	✓	✓	✓	✓	✓
Household Asset Index	✓	✓	✓	✓	✓	✓	✓	✓

^ $p<0.20$, * $p<0.10$, ** $p<0.05$

Models (13) and (15) do not include Mother's BMI

Appendix. Table 3. Independent *t*-tests Comparing Mean Anthropometry Scores with Participation Indicators

			HAZ-score				WHZ-score					WAZ-score				
	n	DF	Mean	SD	t	p	Mean	SD	t	p		Mean	SD	t	p	
Participation in Farm Decisions																
All Households	221	219														
Low	153		-1.16	1.20			-0.49	1.30				-1.34	1.22			
High	68		-1.14	1.14	-0.08	0.93	-0.22	1.08	-1.50	0.13		-1.15	1.25	-1.05	0.29	
Stratified by Men Headed Households	188	186														
Low	132		-1.18	1.23			-0.50	1.33				-1.35	1.24			
High	56		-1.14	1.08	-0.63	0.53	-0.12	1.04	-1.89	0.06	*	-0.99	1.10	-1.84	0.07	*
Women Headed Households	33	31														
Low	21		-1.05	1.01			-0.44	1.13				-1.29	1.10			
High	12		-1.55	1.35	1.21	0.23	-0.68	1.20	0.58	0.57		-1.88	1.68	1.22	0.23	
Farm Decisions made by Any Women																
All Households	221	219														
Fewer Decisions	155		-1.15	1.19			-0.52	1.19				-1.37	1.12			
More Decisions	66		-1.16	1.17	0.05	0.96	-0.12	1.33	-2.22	0.03	**	-1.07	1.45	-1.64	0.10	*
Stratified by Men Headed Households	188	186														
Fewer Decisions	147		-1.18	1.16			-0.50	1.19				-1.37	1.10			**
More Decisions	41		-1.10	1.29	-0.77	0.44	0.05	1.42	-2.50	0.01	***	-0.79	1.46	-2.76	0.01	*
Women Headed Households	33	31														
Fewer Decisions	8		-0.72	1.64			-0.92	1.14				-1.40	1.50			
More Decisions	25		-1.40	0.92	1.49	0.15	-0.40	1.14	-1.14	0.26		-1.54	1.32	0.26	0.80	
Level of Sole Decision-making on Land Resources																
All Households	221	219														
Very Low Access	63		-1.06	1.26			-0.48	1.14				-1.29	1.08			
Some Access	158		-1.19	1.15	0.75	0.45	-0.37	1.28	-0.61	0.54		-1.28	1.29	-0.03	0.98	
Stratified by Men Headed Households	188	186														
Very Low Access	55		-1.04	1.28			-0.48	1.15				-1.25	1.09			
Some Access	133		-1.18	1.15	0.75	0.45	-0.34	1.30	-0.65	0.52		-1.24	1.26	-0.06	0.95	
Women Headed Households	33	31														
Very Low Access	8		-1.21	1.14			-0.55	1.09				-1.53	1.07			
Some Access	25		-1.24	1.17	0.08	0.94	-0.52	1.17	-0.06	0.95		-1.50	1.44	-0.05	0.96	

* p<0.10, ** p<0.05, *** p<0.01