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Access to Agricultural Markets: Gender Considerations Towards Improved Households' Dietary Diversity in Kenya

Evelyne Kihiu

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Evelyne Kihiu

Kenya Institute for Public Policy
Research and Analysis

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Abstract

Achieving food and nutritional security by all people at all times is a key development goal at the global, regional and national levels. Gender mainstreaming in food and nutritional policies, programmes and projects is increasingly being recognized as important to the realization of SDG 2¹. In addition, access to well-functioning markets is likely to improve farmers profitability and their access to diverse nutritious foods. This paper avails the evidence of gendered access to organized agricultural markets on household dietary diversity scores in Kenya using nationwide survey data. Using an inverse probability weighted treatment-effect estimator, we evaluate whether improving women's and men's access to well-functioning agricultural markets facilitates diet diversity among households. The analysis shows that while improving both women and men's agricultural commercialization through organized marketing systems improves the dietary diversity outcomes of households, the effect on women is double that of men. However, greater effects are achieved when both the female and male in the same household have access to well-functioning agricultural markets. Further, addressing human and socio-economic needs of households are also important in enhancing households' dietary diversity quality.

Keywords: *Nutrition security, Agricultural markets, Females, Males, Kenya*

¹ To achieve access to sufficient safe food of acceptable quality at all times.

Abbreviations and Acronyms

ASDSP	Agricultural Sector Development Support Programme
ASTGS	Agricultural Sector Transformation and Growth Strategy
ATE	Average Treatment Effect
AUC	African Union Commission
DD	Dietary Diversity
FAO	Food and Agriculture Organization
HDDS	Household Dietary Diversity Score
IFPRI	International Food Policy Research Institute
IFRC	International Federation of the Red Cross
IPW	Inverse Probability Weighted
IPWRA	Inverse-Probability-Weighted Regression-Adjustment
KIPPRA	Kenya Institute for Public Policy Research and Analysis
OME ₀	Untreated potential-outcome equations
OME ₁	Treated potential-outcome equations
PO mean	Potential outcome mean
RA	Regression Adjustment
SDG	Sustainable Development Goal
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
WEAI	Women's Empowerment in Agriculture Index

Table of Contents

Abstract.....	iii
Abbreviations and Acronyms	iv
1. Introduction.....	1
1.1 Problem Statement	2
1.2 Objective of the Study	4
2. Overview of the Nutrition Status in Kenya: Dietary Intake Counts.....	5
3. Institutional Framework on Gender and Agricultural Markets for Improved Food and Nutrition Security in Kenya	8
4. Theoretical and Empirical Literature	10
4.1 Theoretical Framework.....	10
4.2 Empirical Literature	10
5. Methodology.....	14
5.1 Conceptual Framework	14
5.2 Data and Variables	15
5.3 Empirical Estimation	17
5.3.1 Impact of woman’s sale market access on household’s dietary diversity score.....	18
5.3.2 Impact of men’s market access on household’s dietary diversity score	19
5.3.3 Impact when both women and men in a household have market access	19
6. Results and Discussion	21
6.1 Impact of Access to Organized Agricultural Markets on Food Security	24
6.2 Additional Determinants of Household Dietary Diversity Scores	29
6.2.1 Untreated potential-outcomes	29
6.2.2 Treated potential-outcomes	30
7. Conclusion and Policy Implications.....	32
References	34
Appendix.....	41

List of Figures

Figure 1: Percentage of stunted and wasted children under 5, 1987–2014	6
Figure 2: Conceptual framework linking market access to dietary diversity	14
Figure 3: Kernel density distribution of dietary diversity by treatment group.....	23
Appendix Figure 1: Trend, projection and targets in the prevalence and number of children (under-five) stunted in Kenya.....	41

List of Tables

Table 1: Status of various forms of malnutrition in Kenya.....	5
Table 2: Descriptive statistics.....	22
Table 3: Impact of woman’s sale agreements (market access) on household’s dietary diversity score	25
Table 4: Impact of men’s sale agreements (market access) on household’s dietary diversity score.....	26
Table 5: Impact of combined gender’s sale agreements (market access) on household’s dietary diversity score.....	28

1. Introduction

Improved nutrition is a core concept in development dialogue, alongside priorities such as poverty eradication, health, education and food security. The African Union's Agenda 2063 aims at Africa being amongst the best performance in nutrition among other development areas (AUC, 2015). The above goal is in line with the Sustainable Development Goal (SDG) No. 2 of ending hunger, achieving food security and ending all forms of malnutrition by 2030. Though nutrition is mentioned as a goal in SDG No. 2, nutrition is linked to all the 17 goals (Webb, 2014). The United Nations System Standing Committee on Nutrition in 2004 highlights that nutrition can strengthen key development mechanisms and instruments such as poverty reduction, improved governance and human rights, health sector reforms and trade liberalization (Haddad et al., 2004). The multidirectional relationship among nutrition and the developmental goals underscores its importance as it underpins sustainable development.

For a long time, adequate nutrition has been equated to food accessibility. While access to food is necessary for adequate nutrition, it does not guarantee it (UNICEF, 1990). Webb (2014) defines nutrition as a characteristic of the quality of an individual's diet in relation to their nutrient needs. From the definition, good nutrition goes beyond eradication of hunger; it is significant in the foundations of the well-being of an individual at the economic, social and cultural levels (Republic of Kenya, 2011; Webb, 2014; UNICEF, 2018). Dietary diversity (DD) is recognized as an indicator of diet quality, which influences nutrition outcomes (Fischer and Qaim, 2012; Webb, 2014; Sraboni et al., 2014; Lockett et al., 2015; Sibhatu et al., 2015; Hoddinott et al., 2015; Abay and Hirvonen, 2017; Koppmair et al., 2017; and Sibhatu and Qaim, 2018b). DD has a central role in human nutritional outcomes and human capital, a fundamental human asset (Lockett et al., 2015). To underscore the importance of adequate and diversified diets on nutrition, the UNICEF framework of causality in malnutrition highlights inadequate dietary diets as a key immediate cause of maternal and child undernutrition (Lele et al., 2016; UNICEF, 2015; UNICEF, 1990).

Research studies further illustrate the use of Household Dietary Diversity Score (HDDS) as the best indicator to approximate dietary diversity at the household level (Gillespie et al., 2012; Headey and Ecker, 2013; Ecker, 2018). While the importance of adequate diet is acknowledged, discussions on how dietary diversity is achieved at the household level have been limited (Lockett et al., 2015). Identification of the pathways to achieving household dietary diversity is crucial for integration in policies, programmes, projects and other designed interventions intended to have a positive impact on nutritional outcomes.

Right at the household level, gender-sensitive approaches are likely to have greater impact in delivering developmental outcomes such as access to adequate and appropriate diets. Consideration of gender in development programmes is especially important in the African context where there is a broad division in the responsibilities of men and women, and how they use their personal income (World Bank et al., 2009; Akresh, 2008; Djebbari, 2005). Relative to men, women are documented in various studies to invest a higher proportion of their incomes within their households and towards consumption of the various food groups that is Pareto-superior to that chosen by men (Djebbari, 2005; World Bank et al., 2009). Thus, women's access to and control over and utilization of agricultural resources is significant to household's food security and has the potential of creating tangible benefits to household dietary diversity.

1.1 Problem Statement

Literature shows that access to well-functioning markets is likely to: support the diversification of agricultural production and expansion of the export market base; facilitate food access through movement of farm output from glut areas; link farmers to high end markets, thereby facilitating access to more productive technologies and improving overall profitability; and enhance household dietary diversity to improve nutrition, which is the focus of this study (FAO, 2011; KIPPRA, 2018; Republic of Kenya, 2018; Signorelli et al., 2017).

In particular, in Kenya, purchases are a key source of food consumption and thus dietary intake. Looking at food consumption distribution, nationally, 68.3 per cent of total food consumed is from purchases while 18 per cent is from own production (KNBS, 2018). In rural, peri-urban and core-urban areas, households mainly source their food from purchases, accounting for 57.4 per cent, 65.6 per cent and 85.7 per cent of total food consumed, respectively (KNBS, 2018). Household food purchases by point of purchase at the national level are 27.9 per cent from general shops, 26.6 per cent from open markets, and 22.0 per cent from kiosks. A significant share of rural households (30%), peri-urban areas (32.6%) and core-urban (22.4%) purchase food items from open markets. On the other hand, 32.5 per cent, 26.5 per cent and 23.6 per cent of households in rural, peri-urban and core-urban households purchase food items from general shops (KNBS, 2018). As such, among agricultural households, income earned through the marketed sales of food produced plays a significant role in access to diverse diets through purchased food.

Though both women and men are highly active in the production of agricultural products, women in agriculture experience limitations to desired end markets,

with the constraints being more acutely experienced by women residing in rural areas (MoALF&I, 2019). Differences in market opportunities arise due to various factors, including: lack of informed policies and structures that take into consideration the differing needs and potential of women and men; lack of security and mobility; high cost of transportation; lack of adequate financial assets to support businesses; stigmatization of women in male-dominated fields; limited information and access to training; subsistence production orientation, which limits market competitiveness and capacity to comply with international standards; and time constraints (Adam et al., 2017; Benjamin and Meyers, 2016; HBF, 2015; Quisumbing and Pandolfelli, 2010). Women may also be limited by traditional social norms on what they may grow and, in turn, this would limit market opportunities, including formal market opportunities they are likely to exploit (Benjamin and Meyers, 2016).

The agricultural income of women is thus affected negatively with possible negative effects on nutritional outcomes of households. With the broad division of responsibilities between men and women in households, less income accruing to women would affect their share of responsibilities, including provision of diets with adequate nutrition. Recognition of intra-household heterogeneity in agricultural market access, by differentiating between women and men within households and recognizing their diversity in market access, can mean better capabilities of households in improving diets and enhance other developmental outcomes. As highlighted by Pandey et al. (2016), a key hindrance to this is the poor evidence to determine the extent to which women's empowerment in areas such as access to well-functioning markets can bring about an improvement in nutritional status in families.

Agricultural market-oriented interventions aimed at facilitating women's market access will be more effective if women have control of their market sales. In addition, the interventions will be effective if the market channels allow female farmers to regularly market their produce; that is, enable women to produce for the market rather than trying to market what they produce (Kaaria et al., 2008). Linking farmers to organized markets, for instance through contractual agreements in advance of production assures farmers of markets while the agreed prices help in reducing income volatility (Njuki et al., 2011).

A few studies have explored gender issues in agricultural marketing and their related effects on dietary outcomes at the household level. In Kenya, empirical literature on gender, agricultural marketing and dietary outcomes relate to: evaluation of the linkages of farm production diversity and dietary quality (Sibhatu and Qaim, 2018b); analysis of the distribution of income between men and women in agricultural households, looking at what influences control of income

from agricultural markets, and the differences in expenditure patterns for income controlled by men and women (Njuki et al., 2011); and gender implications of farmer groups on agricultural commercialization (Fischer and Qaim, 2012). From the existing literature, we are not aware of any previous study that has explicitly looked at how intra-household heterogeneity in access to organized agricultural markets affects dietary diversity outcomes and related implications for nutrition among households. This evidence is necessary for specific policy action to closing the gender gaps in access to agricultural markets for improved nutritional outcomes.

1.2 Objective of the Study

Towards filling this gap, this paper aims at assessing evidence of gendered access to organized agricultural markets (where farmers are linked with buyers in advance of production) on household dietary diversity scores in Kenya. We hypothesize that women's access to organized agricultural markets will enable female farmers to regularly market their produce at stipulated prices. In addition, organized markets are likely to reduce various transactional costs, such as costs related to searching for buyers and would also allow intermediaries to be bypassed. Market assurance coupled with reduced transactional costs are likely to improve agricultural income accruing to women, and thereby promote their contribution to household's healthy and diversified dietary intake.

Specifically, the study aims at:

1. Assessing households' dietary diversity performance;
2. Assess women's access to organized agricultural markets and how this compares to that of men in a household; and
3. Evaluate the effect of women's access to organized agricultural markets in a household on dietary diversity score and how this relates to men's access.

The analysis will help strengthen policy recommendations based on evidence regarding gender-specific agricultural interventions for improved nutrition.

The rest of the study is structured as follows: In section 2, we present an overview of the nutritional status in Kenya. Section 3 presents the nexus between agriculture, gender, dietary diversity and markets while Section 4 presents the conceptual framework upon which the study is based. Section 5 describes the data and methods used in the analysis. Section 6 presents and discusses the regression results. Lastly, Section 7 presents the conclusion and draws policy implications from the study.

2. Overview of the Nutrition Status in Kenya: Dietary Intake Counts

Kenya’s 2010 Constitution recognizes adequate nutrition as a human right. It states that every person has the right to adequate food of acceptable quality and that every child has the right to basic nutrition. This includes having physical and economic access to sufficient, safe, and diverse categories of nutritious food to meet their nutritional needs for an active and healthy life (FAO, 2009; Sibhatu et al., 2015; FAO, 2009; UNICEF, 2018). The government aims to guarantee food security and nutrition to all Kenyans by 2022 (Republic of Kenya, 2018).

Despite the government’s commitment, malnutrition—defined as “a condition that results from lack of food, from not eating the right foods or from the inability to absorb the necessary nutrients from food” (IFRC, 2013)—remains of concern in the country. Looking at the various facets of malnutrition in 2015 as shown in Table 1, about 27 per cent of Kenyans were either overweight or obese (UNICEF, 2018). A higher percentage of women (37.5%) are either obese or overweight compared to men (17.5%). The latest demographic health survey in the country, the Kenya Demographic and Health Survey 2014, observed that 4 per cent of children under 5 years¹ were overweight/obese (KNBS et al., 2015).

Table 1: Status of various forms of malnutrition in Kenya

Overweight or obese	%		%
National Level	27	Men	17.5
Women	37.5	Children	4.0
Micronutrient Deficiencies			
Iron Deficiency		Zinc Deficiency	
Pre-School Children	21.8	Pre-School Children	81.6
School Age Children	9.4	School Age Children	79.0
Pregnant Women	36.1	Pregnant Women	67.9
Non-pregnant Women	21.3	Non-pregnant Women	79.9
Men	3.6	Men	77.4
Vitamin B12 Deficiency		Iodine Deficiency	
Pregnant Women	7.7	School age Children	22.1
Non-pregnant Women	34.7	Non-pregnant Women	25.6
Additional Children Nutritional Status			
Stunted	26.0		
Wasted	4.0		
Underweight	11.0		

Sources: Highlighted from various key report findings: KNBS et al. (2015); UNICEF (2018); Kenya National Micronutrient Survey of 2011

¹ Children with +2 standard deviation (SD) above the median weight-for-height are considered overweight or obese

Other facets of malnutrition include micronutrient and macronutrient deficiencies. The body requires macronutrients such as carbohydrates, proteins and fats to function correctly and grow normally (IFRC, 2013). Protein-energy malnutrition is associated with wasting, stunting, and underweight (De Onis et al., 1993; Oluchina, 2017). Micronutrient deficiencies can reduce the body’s capacity to fight diseases, and hamper its use of foods and the absorption of the nutrients that the body requires to grow and function. Micronutrient deficiencies can also cause wasting, stunting and nutritional oedema (IFRC, 2013).

Some key outcomes from the most recent national micronutrient survey in the country, the Kenya National Micronutrient Survey of 2011, are highlighted in Table 1. Children were observed to have high levels of Iron, Zinc and Iodine deficiencies. Majority of the men population had Zinc deficiencies while women were observed to have Iron, Folate, Zinc and Vitamin B₁₂ deficiencies.

Children are most vulnerable to stunting, wasting and being underweight (IFRC, 2013). In the National Nutrition Action Plan 2012-2017, the Government of Kenya had committed to reduce stunting to 14 per cent, wasting to 2 per cent and underweight levels among children under 5 years to 10 per cent by 2017 (Republic of Kenya, 2012). Trends over the years indicate that stunting and wasting are declining too slowly, while still impacting the lives of far too many young children and thus the government is likely not to have achieved its target (Figure 1 and Appendix Figure 1).

Figure 1: Percentage of stunted and wasted children under 5, 1987–2014



Source: UNICEF Data and Analytics: <https://data.unicef.org/resources/JME/>

Poor nutritional outcomes have particularly devastating consequences on development of children with lasting impacts on their physical, mental and social development, which ultimately affects their capabilities in life. Malnutrition in children is particularly associated with poor feeding practices, poor maternal nutrition, inadequate access to health and low access to adequate and diversified

diets, which is the focus of this study (Republic of Kenya, 2012). Apart from reducing wasting and stunting, there are positive impacts of alleviating micronutrient and macronutrient deficiencies on health, productivity, and in the long-run on national economies through promotion of healthy and diversified dietary practices (Darnton-Hill et al., 2005; Republic of Kenya, 2012).

3. Institutional Framework on Gender and Agricultural Markets for Improved Food and Nutrition Security in Kenya

There are various regional and country-specific initiatives that focus on improving food and nutrition security and boosting markets and trade opportunities in the agricultural sector to achieve key developmental goals. At the regional level, among the key commitments of the African Union's 2014 Malabo Declaration on '*Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods*' include: ending hunger and improving nutritional status in Africa by 2025; halving poverty by the year 2025 through inclusive agricultural growth and transformation; and harnessing markets and trade opportunities. While the highlighted commitments appear as free-standing elements, in reality they are interwoven. Facilitating and strengthening gender-inclusive agricultural growth and transformation strategies, such as enhanced agricultural markets and trade opportunities, is likely to improve farmers' incomes and enhance access to nutritious foods.

In Kenya, during the plan period of the Second Medium Term Plan (MTP II) (2013-2017), key agricultural areas of focus included enhancing national food and nutrition security and improving market access and trade for agricultural products (Government of Kenya, 2013). Further, the Government under the "Big 4" agenda (2018-2022) prioritizes policies, programmes and projects that will ensure that all citizens enjoy food security and improved nutrition by 2022 (Government of Kenya, 2018). Towards this, the country's 10-year Agricultural Sector Growth and Transformation Strategy (ASTGS) 2019-2029 seeks to rapidly transform the agricultural sector to achieve the country's potential in realizing food and nutrition security. The strategy further highlights that while women in the country are key actors at the heart of agricultural transformation, women in the agricultural sector cannot successfully make the linkages between household production and food and nutrition without the support of the market element. The strategy therefore aims to increase access to well-priced markets with the main goal of increasing small-scale farmers' incomes by supporting farmer-facing SMEs. Farmer-facing SMEs are viewed as capable of raising incomes for small-scale farmers by supporting market access (MoALF&I, 2019). To ensure gender inclusion and strong participation of SMEs led by women, the strategy advocates for a minimum of 33 per cent of women-led businesses with a minimum of 33 per cent overall employment of women in the selection of the SMEs to be supported. This study seeks to further avail evidence on the gender-market access linkages for improved households' dietary diversity and thereby better nutrition outcomes.

Similarly, Kenya's National Food and Nutrition Security Policy Implementation Framework 2017-2022 highlights the need to expand food trade and market opportunities in the agricultural sector to enhance access to food that is diversified. This is important in promoting health and overall food and nutrition security. As such, the framework provides strategic interventions necessary for the expansion of food trade and market opportunities at domestic, regional and global levels. Missing in its strategic interventions to strengthen commercialization of agriculture for improved food and nutrition security are gender considerations as explicitly brought out in its interventions in other areas such as on "Improvement and expansion of on-farm and off-farm employment". Policy formulation and budget support at the national and county levels towards incorporating tailored gender solutions to improve market access and access to affordable diversified foods requires evidence on the postulated linkages. As such, this study seeks to contribute towards availing evidence how intra-household heterogeneity in access to organized agricultural markets affects households' dietary diversity for better nutrition outcomes.

4. Theoretical and Empirical Literature

4.1 Theoretical Framework

While most of the analysis of farmer market linkages is based on the traditional theory of a unitary household model, where income and resources are pooled and allocated according to a joint utility function, recent evidence has been towards a model of intra-household resource allocation (Kristjanson et al., 2010; Meinzen-Dick et al., 2011; Njuki et al., 2011; Udry, 1996). Within the intra-household resource allocation models, households do not always function as a joint single unit. Household members do not always have the same preferences and neither does pooling of resources fully occur within households (Meinzen-Dick et al., 2011; Njuki et al., 2011). The intra-household model allows for differences in preferences among household members, thereby leading to differences in how household members spend their incomes (Njuki et al., 2011).

Thus, from the intra-household dynamics, the impact that access to higher value markets would have on developmental outcomes, such as improved household dietary outcomes, is determined not only on its effects on households' incomes but also on who in the household controls and manages the agricultural commercialization proceeds (Kristjanson et al., 2010; Njuki et al., 2011).

Although increasing the participation of women in organized agricultural markets clearly has the potential to improve dietary diversity of households, evidence of such improvements in dietary outcomes needs to be evaluated for evidence-based policies to eliminate challenges and identify strategies that would help women access more organized agricultural markets.

4.2 Empirical Literature

Agriculture is recognized as having the potential for providing nutritious food for all and promote sustainable livelihoods (UN, 2015). The link between nutrition and women's empowerment in the agricultural sector is particularly important given their involvement in the sector (IFPRI, 2011). Various studies have been carried out to establish pathways through which agriculture can improve nutrient intake and nutritional outcomes of households. Increased agricultural production and productivity of diverse nutrition rich products, including animal-sourced foods increase household's food supplies and can potentially improve dietary intake and nutritional outcomes of households (Johnson et al., 2016; Kadiyala et al., 2014; Pandey et al., 2016; Signorelli et al., 2017). Further, agricultural income may directly or indirectly contribute to improved nutrition. Rising incomes have a strong positive gradient with household dietary diversity (Kadiyala et al., 2014).

Increased incomes have a significant positive effect on increased food expenditure, and this may play an important role in diet diversification (Pandey et al., 2016).

Narrowing to women in agriculture, studies covering South Asian countries illustrate that women's empowerment, measured using the Women's Empowerment in Agriculture Index (WEAI), has a positive association with household dietary diversity (Malapit et al., 2015; Sraboni et al., 2014; Sraboni and Quisumbing, 2018). Women's empowerment is particularly shown to mitigate the negative effect of low production diversity on households' diets; that is, women's empowerment extenuates negative outcomes in households with less diverse production (Malapit et al., 2015). In situations where diversification of household's agricultural production may be limited, women's empowerment may be an important pathway for improving diets and long-term nutritional status in households (Malapit et al., 2015).

Female headship of households is shown to have a positive effect on household dietary diversity (Signorelli et al., 2017), suggesting the importance of improving females management and control over resources in interventions that aim to promote household's dietary diversity. The dichotomy between men and women responsibilities and their differential expenditure patterns are observed to be in line with traditional cultures and the model of intra-household resource allocation (Ngigi et al., 2017; Njuki et al., 2011; Quisumbing et al., 2015). The traditional responsibilities within households are such that issues of food are expected to be dealt with by women (Njuki et al., 2011). In a model of intra-household resource allocation, income is not always pooled within households but can be held and managed separately by individuals (Ngigi et al., 2017; Njuki et al., 2011; Quisumbing et al., 2015).

The above pathways highlight the important role women in agriculture play in improving dietary scores for their families. In Kenya, women particularly play an important role in the agricultural sector. The 2018 UNCTAD report on *East African Community Regional Integration: Trade and Gender Implications* indicates that 76 per cent of women in Kenya are employed in agriculture. There are both shared roles and gender-specific roles where men and women perform certain traditionally distinctive roles in agriculture (Benjamin and Meyers, 2016). Women often grow food crops to provide food for their families and sell the surplus to obtain additional income. Given that women generally serve as the gatekeepers of household nutrition, their role in agriculture has the potential of creating tangible benefits to households through provision of greater variety of foods for their families. Food consumption is, however, strongly affected by availability/access of food and availability of income, among other factors.

In assessing the role of markets in household dietary diversity, literature highlights the need for improving agricultural markets functioning to address food and nutrition insecurity (FAO, 2011; von Braun, 2009). In a review of four agricultural project interventions in Mozambique, Bangladesh, Burkina Faso and Uganda (Quisumbing et al., 2015), market-oriented and high value agriculture are considered as profitable livelihood strategies that can increase women's status in income and stock of assets (Quisumbing et al., 2015). Higher women's status is likely to impact positively on household's nutritional outcomes as shown by Smith et al. (2003) in South Asia, Sub-Saharan Africa (SSA), and Latin America and the Caribbean (LAC). The higher a woman status, the higher the nutritional status for the family is likely to be through her effective care for herself and her family. However, across diverse regions and contexts, women face difficulties in accessing marketing channels, particularly those that allow added value (FAO, 2011; Republic of Kenya, 2019).

Research findings in East Africa suggest that nutrition-sensitive agricultural interventions that promote productivity to increase household incomes together with a push for deeper market integration are more effective in improving diet diversity than those encouraging households to produce a diverse basket of foods (Hirvonen and Hoddinott, 2014). Production diversity is, however, found to be particularly strong with limited market access. Another piece of empirical evidence from Koppmair et al. (2017) in Malawi indicates that though production diversity positively impacts on dietary diversity, the estimated effect is small. Contrary, Ecker (2018) in Ghana notes that while production diversity and income matter for household dietary diversity, the effect of production diversity is greater than the indirect income effect. Similarly, in Ghana, Signorelli et al. (2017) indicate that while agricultural production diversity and productivity positively affect dietary diversity, production diversity gets stronger with limited access to markets. Bhagowalia et al., (2012) also find agricultural productivity to have a substantial impact on household dietary diversity in India. While the importance of farm production diversity versus income on household dietary diversity is context-specific, it is clear that both agricultural production diversity and productivity, and thus income, positively affect dietary diversity, with the effect of increased productivity coupled with better market access mitigating the effects of less diverse production.

Further evidence in Northern Ethiopia indicates that children located closer to food markets consume more diverse diets and are better nourished compared to those located in more remote areas (Abay and Hirvonen, 2017). Drawing on insights from their study, Hirvonen et al. (2017) find that the effect of nutrition knowledge on children's dietary diversity is positive only in areas with relatively good market access in Ethiopia. The effect of nutritional knowledge on nutritional

outcomes decreases as households are located farther from the main markets. Evidence from East Africa, in Malawi, Tanzania and Uganda, indicates that even the poor and smallest land holders participate in markets where a considerable percentage of the market presence is driven not necessarily by cash crops but by the sale of staple and other food crops (Carletto et al., 2017). However, agricultural commercialization involves the sale of relatively small quantities of food commodities resulting in low household crop commercialization index.

In addition, though female farmers participate less in market activities, greater involvement by women in commercialization reduces the likelihood of a child being wasted, an indication that the owner of the revenue from agricultural sales could be important for improved nutritional outcomes (Carletto et al., 2017). Yet, another piece of empirical evidence in Nepal in South Asia indicates that women empowerment through strategies such as group membership (e.g. in agricultural marketing groups), control over use of income among others mitigates the negative effects of less diverse production on nutritional status of household members (Malapit et al., 2015).

While the evidence presented illustrates that women's disempowerment in markets may negatively impact on dietary diversity of households, improved status in agriculture may increase demands on women's time. An increase in demand for women's time may dampen the possible positive effects on households' diets and overall nutrition due to sacrifices made in other areas such as time allocated to family care (Carletto et al., 2017; Quisumbing et al., 2015). Similar observations are made by Johnson et al. (2016) in their synthesis of findings from projects in seven countries in Africa and South Asia. It is, therefore, important to establish country-specific correlation between household dietary diversity scores and empowerment across various indicators such as access to well-functioning agricultural markets.

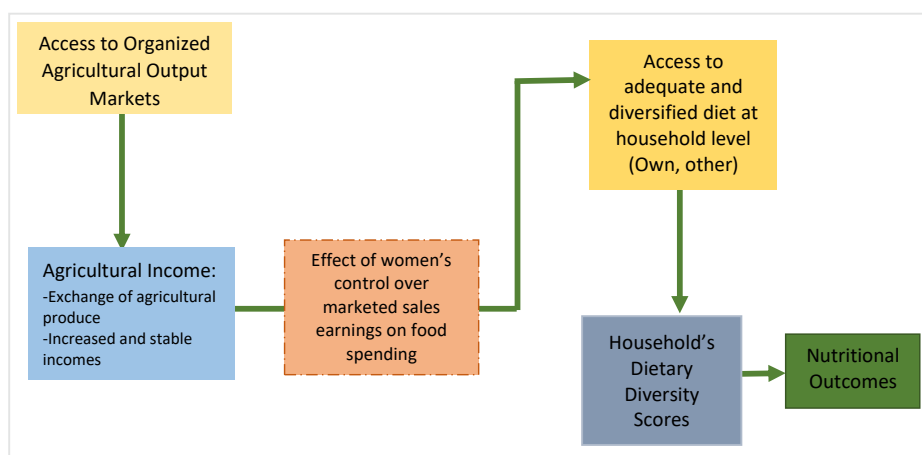
5. Methodology

5.1 Conceptual Framework

The conceptual framework (Figure 2) shows the links between agricultural markets access and households' dietary intake with a focus on the role of women in households obtaining adequate dietary intake. The conceptual framework is built on Kenya's National Food and Nutrition Security Policy Implementation Framework 2017-2022 and the 1990 UNICEF's framework on nutrition (UNICEF, 1990; 2015). The pathway of interest between agriculture and improved household's diets for better nutrition outcomes is through food expenditure from income earned from marketed sales of food produce as delineated in existing literature (Gillespie et al., 2012; Pandey et al., 2016).

Figure 2: Conceptual framework linking market access to dietary diversity

Pathway: Agriculture—Women's marketed sales of agricultural produce—Income —food expenditure— household dietary diversity scores—



Source: Adapted from UNICEF 1990 and Kenya's National Food and Nutrition Security Policy Implementation Framework 2017-2022

Access to organized agricultural markets facilitates trade of agricultural produce. Households may also benefit from increased and stable incomes from farm product sales given organized markets allow farmers to regularly market their produce. This enables the farmers to produce for the market rather than trying to market what they produce as mentioned earlier in the study.

Food access, a key dimension of food security, is achieved either through own production or purchases made. While the study acknowledges that adequate

dietary intake can be achieved either through production of diverse nutrition-rich products and/or the agricultural income channel, the focus of this study is the latter channel. From literature, there are gender differences on income spending where women spending towards food and nutrition has been observed to be Pareto-superior to that of men. Women are likely to spend more towards accessing sufficient, safe and nutritious food to meet households' dietary needs.

When adequate dietary intake is achieved, and assuming appropriate intra-household distribution of food and proper health care, the households are then likely to realize improved nutrition. This paper hypothesizes that women's access to adequate agricultural markets is positively associated with improved dietary intake of households. Given women's provisioning role in the country, we postulate that women are better able to command agricultural resources from markets needed to improve household's dietary diversity.

5.2 Data and Variables

The data is drawn from the Kenyan Agricultural Sector Development Support Programme (ASDSP) household baseline survey carried out during September–October 2013. The ASDSP household survey was carried out in all the 47 counties of Kenya by the Ministry of Agriculture, Livestock and Fisheries (MoALF) through the ASDSP, in collaboration with the Kenya Agricultural Research Institute (KARI) and the University of Nairobi (UoN). The overall sample size of the household survey was 12,651 agricultural households focusing on resources, climate change and food security. Gender-sensitive analyses require data collection approaches whereby females and males in a household are interviewed individually - intra-household level data (Ngigi et al., 2017). Intra-household level data is especially important in identifying gender differences in agriculture for appropriate policy action (Ngigi et al., 2017; Njuki et al., 2011; Quisumbing et al., 2015). A key strength of the ASDP household survey is that it contains gender-disaggregated data for effective gender analysis.

Dietary diversity at the household level can be measured by a household dietary diversity score (Swindale and Bilinsky, 2006). Household Dietary Diversity Score (HDDS) is normally constructed using information on household food consumption based on a 24-hours recall period (Swindale and Bilinsky, 2006). HDDS is measured as the count of 12 different food groups consumed on a 24-hours recall period using household food consumption data. The food groups used to calculate the HDDS include cereals; roots and tubers; vegetables; fruits; meat, poultry, offal; eggs; fish and seafood; pulses/legumes/nuts; Milk and milk products; oils/fats; sugar/honey; and miscellaneous which include spices,

condiments and beverages (Swindale and Bilinsky, 2006). Thus, the HDDS indicator is calculated as follows:

The 12 food groups used to calculate the HDDS indicator:

A	Cereals	G	Fish and seafood
B	Roots and tubers	H	Pulses, legumes, nuts
C	Vegetables	I	Milk and milk products
D	Fruits	J	Oil/fats
E	Meat, poultry, offal	K	Sugar/honey
F	Eggs	L	Miscellaneous

Each food group is assigned a score of 1 (if consumed) or 0 (if not consumed). On a 24 -hour recall period, a household score will range from 0 to 12 and is equal to the total number of food groups consumed by the household:

$$HDDS = Sum (A + B + C + D + E + F + G + H + I + J + K + L)$$

However, the dataset used in this study does not have dietary data based on a 24 -hour recall period. Due to the data limitation, HDDS has been based on 7-day diet recalls as used in various other studies faced with the same limitation (Sibhatu et al., 2015; Sibhatu and Qaim, 2018a; Sraboni et al., 2014; Thorne-Lyman et al., 2010). HDDS is thus calculated from the number of different food groups consumed over a 7-day reference period (Thorne-Lyman et al., 2010). Each food group counts towards the household score if a food item from the group was consumed in the household over the 7-day recall period. HDDS is therefore a continuous score (Jones et al., 2014) where over a 7-day reference period, a household score will range from 0 to 84; equal to the total number of food groups consumed by the household (Thorne-Lyman et al., 2010).

The key independent variable, access to organized agricultural markets, is defined as access to markets where the farmer has been linked to a buyer (Njuki et al., 2011). Agricultural market-oriented interventions aimed at facilitating women's market access will be more effective if women have control of their market sales. In addition, the interventions will be effective if the market channels allow the female farmers to regularly market their produce; that is, enable the women to produce for the market rather than trying to market what they produce (Kaaria et al., 2008). Linking with farmers with buyers through contractual agreements in advance of production assures farmers of markets, while the agreed prices helps in reducing income volatility (Njuki et al., 2011). In construction of the market access variables, we consider who within the household controls market sales to get a sense of decision making (Fischer and Qaim, 2012) and the market sold,

identifying the presence or absence of contractual agreements with the buyer, as has been used in existing studies (Kaaria et al., 2008; Njuki et al., 2011). Thus, the access to organized agricultural markets variable is a dummy variable, which takes the value of 1 where the individual has control of market sales and there is presence of contractual agreements with the buyer, and 0 otherwise. Table 2 in the results section shows a description of the variables used in analyzing the effect of gendered access to organized agricultural markets on household dietary diversity scores in Kenya.

5.3 Empirical Estimation

In the analysis, we aim at finding out if access to organized markets in agriculture has an effect on household dietary diversity scores (HDDS). To be able to evaluate the effect women's access to organized agricultural markets has on household dietary, in an ideal world, we would observe the same subject before and after they have access to the markets under identical conditions, such that the difference is only attributed to the presence or absence of markets. That is, we would need the counterfactual outcome for the subject under study. The ideal experiment described is, however, almost never possible as it is impossible to observe the same subject having access to markets and not having access to markets. A classic solution to the problem is to randomize the sample under study. However, in our study, as is the characteristic of observational data, access to organized markets is not randomized.

The study employs a treatment-effect estimator, which allows us to estimate the effectiveness of treatment using observational data where treatment status, in this case access to organized markets, is not randomized (Wooldridge, 2004). The estimators enable us to estimate the outcome for that same subject if they had been exposed to treatment; counterfactual outcomes.

To estimate the treatment effects, this study employs the Inverse-Probability-Weighted Regression-Adjustment (IPWRA) estimator. The IPWRA estimator is a general approach to solving the non-random sampling problem in treatment effects estimation and combines the Regression Adjustment (RA) and Inverse Probability Weighted (IPW) estimators to enhance robustness; a double robust estimator (Jordà and Taylor, 2013; Wooldridge, 2004; 2010). Rather than using the simple group means consisting of the difference between two sub-populations to obtaining an estimate of the average treatment effect (ATE), the RA estimator uses a regression model to predict potential means adjusted for covariates. That is, the ATE in an RA estimation is estimated using the conditional mean average predicted by regression estimates of each sub-population (Jordà and Taylor,

2013). IPW estimator uses weights to generate a pseudorandomized sample from which the simple difference in group means will deliver the correct effects of treatment (Jordà and Taylor, 2013).

In estimating the ATE, we are interested in obtaining the difference between the average outcome of treatment and control group (Gertler et al., 2016; Jordà and Taylor, 2013; Wooldridge, 2004; 2010):

$$ATE = E [Y_{it} | P = 1] - E [Y_{oi} | P = 0] \quad (1)$$

where:

P is the treatment;

$P = 1$ if unit i is exposed to treatment P ;

$P = 0$ if unit i is not exposed to treatment P ;

Y_{it} is the outcome if unit i is exposed to treatment;

Y_{oi} is the outcome if unit i is not exposed to treatment;

and

$E [Y_{it} | P = 1] - E [Y_{oi} | P = 0]$ is the difference between the average outcome of treatment and control group.

In our study, the basic specification of the average effects of treatment (ATE) would be the sample average of dietary score of households with market access $[HDDS_{it} | P = 1]$ minus dietary score of households with no market access $[HDDS_{oi} | P = 0]$ conditional to control variables:

$$ATE = E [HDDS_{it} | P = 1] - E [HDDS_{oi} | P = 0] \quad (2)$$

The availability of gender-sensitive data allows the study to carry out estimations that will help evaluate gender differences on the effect access to organized agricultural markets has on household dietary diversity. The analysis will therefore carry three estimations to assess: (i) women's access; (ii) men's access; and (iii) cases where both the woman and man in a household have access to organized agricultural markets.

5.3.1 Impact of woman's sale market access on household's dietary diversity score

To examine the relationship between women's access to markets and household dietary diversity score, we estimate the following equation:

$$HDDS_i = \beta_0 + \beta_1 P_{iW} + \beta_2 X_i + \varepsilon_i \quad (3)$$

where $HDDS_i$ is the dependent variable defined as household dietary diversity scores in household i , β_i are coefficients to be estimated, P_{iW} is the treatment variable representing 1 if the woman in household i has access to markets and 0 otherwise; X_i is a vector of household-level characteristics, and ε_i is an error term.

On estimating equation 3, the study proceeds to estimate the ATE. ATE is calculated as the difference between average dietary score of households where women in the household have market access (treatment) and where women have no market access (control) as explained in equations 1 and 2. Thus, ATE is estimated as follows:

$$ATE = E [HDDS_{i1} | P_{iW} = 1] - E [HDDS_{i0} | P_{iW} = 0] \quad (4)$$

The results of the above estimations are presented in Table 3 of the results section.

5.3.2 Impact of men's market access on household's dietary diversity score

A similar procedure is followed to examine the relationship between men's access to markets and household dietary diversity score using the following equation:

$$HDDS_i = \beta_0 + \beta_1 P_{iM} + \beta_2 X_i + \varepsilon_i \quad (5)$$

where $P_{iM} = 1$ if the man in the household has access to markets and 0 otherwise.

The study then proceeds to estimate the average treatment effects on household dietary diversity of the above estimation. This is given by the difference between average dietary score of households where men in the household have market access (treatment) and where men have no market access (control) as illustrated below:

$$ATE = E [HDDS_{i1} | P_{iM} = 1] - E [HDDS_{i0} | P_{iM} = 0] \quad (6)$$

The results of the above estimations are presented in Table 4 of the results section.

5.3.3 Impact when both women and men in a household have market access

Finally, the analysis examines the treatment effect where both the man and woman in a household have access to markets on household dietary diversity ($P_{(W\&M)} = 1$ versus $P_{(W\&M)} = 0$):

$$HDDS_i = \beta_o + \beta_1 P_{(iW\&M)} + \beta_2 X_i + \varepsilon_i \quad (7)$$

where $P_{(iW\&M)} = 1$ if both the man and woman in a household have access to markets and 0 otherwise.

Similar to the previous estimations, the ATE of the above estimation is given by the difference between average dietary score of households where both the man and woman in the household have market access (treatment) and where both do not have market access (control) as illustrated below:

$$ATE = E [HDDS_{i1} | P_{(iW\&M)} = 1] - E [HDDS_{oi} | P_{(iW\&M)} = 0] \quad (8)$$

The results of the above estimations are presented in Table 5 of the results section.

6. Results and Discussion

This section presents the results of treatment effects from an Inverse-Probability-Weighted Regression-Adjustment estimation. We estimated the effect of access to organized agricultural markets on household dietary diversity score, controlling for household characteristics. Before proceeding with the average treatment effect results, we present the descriptive statistics of the variables used in the study in Table 2. The average dietary diversity score of households is about 29.9 with a standard deviation of 11.5². The mean household size is 6 with an average annual per capita gross wealth of Ksh 164,086.9. Most households are male-headed (about 92%) and average age of the head of the household is about 51 years. Majority of household heads have farming as their primary occupation and their highest level of education is primary education. A large share of households in the dataset have both a primary female and male adult (88.6 %), while 6.9 per cent and 4.6 per cent only have a primary female adult and primary male adult in the household, respectively. A greater percentage (67.0%) of the land cultivated are arid or semi-arid lands. Although most of the households do not have access to market, about 15.6 per cent, 5.4 per cent and 3.1 per cent of men, women and both the woman and man in a household have access to organized agricultural markets, respectively.

² The minimum and maximum value of the household dietary diversity score is 0 and 66, respectively.

Table 2: Descriptive statistics

Variables	(1) Full Sample Mean	(2) Women's access SD	(3) Men's access Diff. in mean (treated vs control)	(4) Combined access Diff. in mean (treated vs control)	(5) Diff. in mean (treated vs control)
HH Dietary Diversity Score	29.90	11.47	5.12***	3.32***	5.58***
Primary occupation					
Household Dietary Diversity Score (7-day recall, 12 food groups)					
Primary occupation of the household head					
Formal salaried employ (1/0)	0.104	0.306	-0.004	-0.007	-0.004
Farming (1/0)	0.673	0.469	0.058*	0.115***	0.108**
Farming is the primary occupation (YES=1)					
Self-employed (1/0)	0.110	0.313	-0.013	-0.03**	-0.032
Self-employment (YES=1)					
Household size	6.192	2.790	-0.295	-0.45***	-0.278
Number of people in a household					
Age of household head	51.42	13.83	1.848*	1.319**	0.626
Age (in years) of household head					
Highest level of education					
Highest level of education of household head					
No education (YES=1)	0.182	0.386	-0.12***	-0.104***	-0.133***
Primary	0.467	0.499	0.093**	0.035	0.137***
Attained at least Primary Education (YES=1)					
Secondary	0.264	0.441	0.029	0.07***	0.039
Attained at least Secondary Education (YES=1)					
Tertiary	0.087	0.282	-0.005	-0.001	-0.043**
Attained at least Tertiary Education (YES=1)					
Annual per capita gross wealth (log)	11.18	1.402	0.575***	0.495***	0.618***
Gross_wealth (log). Measured by ASDSP as sum of value of all livestock owned, value of household assets and total household income					
Sex of HHead (1/0)	0.923	0.267	0.07***	0.079***	0.07***
Sex of the household head: Male=1, Female=0					
Productivity of land	0.673	0.469	0.233***	0.269***	0.245***
Broad Land Classification according to its potential ³ . Arid and Semi-Arid=0; Higher Potential Land =1					
HH_female adult	0.069	0.253	-0.063***	-0.074***	-0.058***
HH has only female adults (YES=1)					
HH_male adult	0.046	0.209	-0.161	0.015	-0.010
HH has only male adults					
HH_female_male adults	0.886	0.318	0.086***	0.067***	0.075***
HH has both male and female households					
Women's access (1/0)	0.054	0.226			
Woman in the household has access to organized agricultural markets (YES=1)					
Men's access (1/0)	0.156	0.363			
Man in the household has access to organized agricultural markets (YES=1)					
Combined access (1/0)	0.031	0.173			
Both Man and Woman in the household have access to organized agricultural markets (YES=1)					
Observations	3,559				

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

³ Classification based on: Businge, M.S., Ondimu, K., Maina, I., Mutai, C., Ochola, S.O., Ali, A.A. and Nyangena, W. (2011), Kenya State of the Environment and Outlook 2010. Nairobi: National Environment Management Authority.

In the case of either men's and women's market access treatment, we observed significant difference between treated and control groups for almost all the variables except household head in formal salaried employment and have tertiary education. However, for the combined treatment of both man and woman market access, no significant difference is found for self-employment, household size, age and secondary education between treated and control groups. In Figure 3, it can be seen that generally, treated groups have higher household dietary diversity score than the control groups. This is also confirmed in columns (3)-(5) of table 2.

Figure 3: Kernel density distribution of dietary diversity by treatment group



Source: Author's estimations

In this study, three regressions were carried out: (a) in the first, we evaluated the effect of women's access to organized agricultural markets on household dietary diversity scores; (b) in the second, we evaluated the effect of men's access to organized agricultural markets and assess how the results differed with that of women; and (c) lastly, we evaluated the effect of access to organized agricultural markets where both the man and woman in a household have access to organized agricultural markets. The last regression helps to identify the presence or absence of synergy between men's and women's access to organized agricultural markets on household dietary diversity.

In each of the three regressions, we present results on the Average Treatment Effect (ATE) and Potential-Outcome Means (POMs). POMs represent the means of the outcome variable with the subject with access to organized agricultural market (Y_1) and the outcome variable where the subject has no access to organized agricultural markets in the population (Y_o). ATE is the difference in mean (average) outcomes between Y_1 and Y_o ($Y_1 - Y_o$). Further, for each regression, we present the output for those without access to organized markets; that is, the untreated potential-outcome, and those with access to organized markets, also referred to as the treated potential-outcomes. We focus on households with both a primary female and male adult. This will allow for intra-household analysis (Ragasa et al., 2019) in assessing gender differences in the effects of market access on household dietary diversity scores.

The results for the three estimations are presented in Tables 3-5. In all the three regressions, the dependent variable is the household dietary diversity score, as discussed earlier. The results obtained when evaluating the effect of women's and men's access to organized agricultural markets on household dietary diversity are reported in Tables 3 and 4, respectively. Table 5 presents the results obtained when assessing the combined effect of both the man and woman in a household having access to organized agricultural markets.

As can be seen in Tables 3-5, the estimated coefficients in all the three regressions, other than the gender-related variables, are similar in the three regressions as the attributes of the households have not been changed. The results imply that changes observed on the gender-related variables can be attributed to the gender differences across the three regressions. The significant differences in the gender-related variables strongly indicate the importance of gender-specific analyses in food and nutritional studies (Kassie et al., 2014).

6.1 Impact of Access to Organized Agricultural Markets on Food Security

The results reveal that access to organized agricultural markets significantly influences the household dietary diversity scores (Tables 3-5). In Table 3 column 1, after controlling for observable characteristics, we observe that, on average, when a woman in a household has access to organized agricultural markets, the household dietary diversity score improves by 5.297 points.

The results indicate that women's access to organized agricultural output markets seems to be associated with improvements in households' diets. Given production alone may not be sufficient to provide agricultural households with highly diversified output to support diversified diets, agricultural income from enhanced

access to organized markets supports expenditure on additional food categories as conceptualized in Figure 2. Thus, the results suggest that enhanced marketed sales of agricultural produce, through their effects on agricultural income, are a key pathway to improved household dietary diversity scores. The identified pathway is as follows: Agriculture—Marketed sales of agricultural produce— Income —food expenditure— household dietary diversity scores.

Table 3: Impact of woman’s sale agreements (market access) on Household’s Dietary Diversity Score

	(1)	(2)	(3)	(4)
Dependent Variable: HDDS - Household’s Dietary Diversity Score	ATE	POmean	OMEo	OME1
Key independent variable				
The woman in a household has access vs woman has no access to organized markets: ATE	5.297***			
	(0.890)			
The woman in a household has no access to organized markets: $T_w=0$		29.784***		
		(0.209)		
The woman in a household has access to organized markets: $T_w=1$		35.081***		
		(0.866)		
Control variables				
<i>Primary occupation:</i>				
Formal salaried employ			0.831	-4.512
			(0.926)	(4.201)
Farming			0.307	-1.125
			(0.672)	(3.650)
Self-employed			1.515*	3.620
			(0.854)	(3.872)
Household size			-0.291***	-0.185
			(0.077)	(0.332)
Age of household head			0.022	-0.101
			(0.015)	(0.068)
<i>Highest level of education of household head; Base (None=0)</i>				
Primary			2.407***	-4.464*
			(0.615)	(2.651)
Secondary			3.973***	-3.017
			(0.701)	(2.615)
Tertiary			3.091***	0.803
			(0.952)	(4.157)
Gross wealth (log)			1.377***	1.018
			(0.156)	(0.654)
Sex of household head (Female=0)			-0.449	-13.906***
			(1.679)	(2.513)
Land (Arid and Semi-Arid =0)			2.193***	-2.185
			(0.504)	(2.299)

Constant			11.061***	48.824***
			(2.588)	(11.514)
Observations	3,157	3,157	3,157	3,157

ATE= Average Treatment Effect (ATE) [the mean of the difference ($Y_1 - Y_0$)]

PO mean=Potential-Outcome means (means of Y_1 and Y_0 in the population)

OME0= Untreated potential-outcome equations

OME1= Treated potential-outcome equations

Robust standard errors in parentheses: *** $p < 0.01$, ** $p < 0.05$

When a man in a household has access to organized agricultural markets, the household dietary diversity score improves by 1.880 points (Table 4, column 1). While both women’s and men’s access to organized agricultural markets influences household dietary diversity scores positively, the women’s effect is much larger; more than double that of men. The results indicate that where a woman’s socio-economic power in a household is improved through enhanced access to organized agricultural markets, their control of such earnings can significantly improve household dietary diversity scores relative to men.

Table 4: Impact of men’s sale agreements (market access) on Household’s Dietary Diversity Score

	(1)	(2)	(3)	(4)
Dependent Variable: HDDS-Household’s Dietary Diversity Score	ATE	POmean	OME0	OME1
<i>Key independent variable</i>				
The man in a household has access vs man has no access to organized markets: ATE	1.880***			
	(0.697)			
The man in a household has no access to organized markets: $T_M=0$		29.764***		
		(0.224)		
The man in a household has access to organized markets: $T_M=1$		31.664***		
		(0.663)		
<i>Control Variables</i>				
<i>Primary occupation:</i>				
Formal salaried employ			0.610	-3.928
			(0.974)	(3.257)
Farming			0.047	-1.032
			(0.714)	(2.901)
Self-employed			1.314	0.965
			(0.902)	(3.359)
Household size			-0.305***	0.091
			(0.081)	(0.225)
Age of household head			0.015	0.002
			(0.017)	(0.049)

<i>Highest level of education of HH Head; Base (None=0)</i>				
Primary			2.440***	1.883
			(0.660)	(2.335)
Secondary			3.954***	3.146
			(0.754)	(2.409)
Tertiary			3.174***	0.590
			(1.058)	(2.984)
Gross_wealth (log)			1.319***	1.560***
			(0.167)	(0.476)
Sex of HHead (Female=0)			-0.413	-5.015*
			(1.956)	(2.574)
Land (Arid and Semi-Arid=0)			2.238***	-0.195
			(0.526)	(1.880)
Constant			12.311***	17.834**
			(2.840)	(8.534)
Observations	3,157	3,157	3,157	3,157

ATE= Average Treatment Effect (ATE) [the mean of the difference (Y1 - Yo)]

PO mean=Potential-outcome means (means of Y1 and Yo in the population]

OME0= Untreated potential-outcome equations

OME1= Treated potential-outcome equations

*Robust standard errors in parentheses: *** p<0.01, ** p<0.05*

The results are similar to the findings by Njuki et al. (2011) in Malawi and Uganda where women spent a significantly larger share of their proceeds from agricultural commercialization on food items compared to men. Women prioritize food in their expenditure items while the largest share of men's income goes towards assets (Njuki et al., 2011). Similar observations are also made in Malapit and Quisumbing (2015) where dietary diversity scores are greater in female decision maker households compared to male decision maker households. Thus, enhancement of women's income through marketed sale of agricultural produce in organized markets and subsequently, its control is recognized as an additional important pathway to improved household dietary diversity scores. The identified pathway is as follows: Agriculture—Women's marketed sales of agricultural produce—Income—food expenditure—household dietary diversity scores. The highlighted pathway is especially important in the Kenyan household setting where majority of the household heads are male where they play a more dominant role in household decision-making.

The effect on household dietary diversity is, however, largest when both the woman and man in the same household have access to organized agricultural markets. The treatment effect of having both women and men within the same household accessing organized markets has a positive significant effect of 8.054 points on household dietary score (Table 5, column 1). The results highlight

that while it is important to improve women’s access to agricultural markets towards greater dietary diversity scores within households, efforts geared towards gender equity in agricultural markets access are likely to provide better results. In addition, policies that aim at improving both women’s and men’s access in a household are likely to eliminate the predominant zero-sum power conceptions in households that undermine the effectiveness of development initiatives (Aberman et al., 2018). The identified pathway from these results is as follows: Agriculture—Equitable access to agricultural markets—Income—food expenditure—household dietary diversity scores.

Table 5: Impact of combined gender’s sale agreements (market access) on Household’s Dietary Diversity Score

	(1)	(2)	(3)	(4)
Dependent Variable: HDDS-Household’s Dietary Diversity Score	ATE	POmean	OMEo	OME1
<i>Key independent variable</i>				
Both man and woman vs not both man and woman have access to organized agricultural markets: ATE	8.054***			
	(1.025)			
Not both man and woman have access to organized agricultural markets: $T_{(W\&M)}=0$		29.829***		
		(0.206)		
Both man and woman have access to organized agricultural markets: $T_{(W\&M)}=1$		37.883***		
		(1.004)		
<i>Control Variables</i>				
<i>Primary occupation:</i>				
Formal salaried employ			0.868	-9.111**
			(0.910)	(4.281)
Farming			0.340	-5.877
			(0.660)	(4.144)
Self-employed			1.660**	-2.274
			(0.839)	(4.994)
Household size			-0.293***	-0.500
			(0.076)	(0.331)
Age of household head			0.020	0.041
			(0.015)	(0.059)
<i>Highest level of education HH Head (ref: no edu)</i>				
Primary			2.332***	-5.280*
			(0.607)	(2.902)
Secondary			3.843***	-0.792
			(0.692)	(2.848)
Tertiary			2.974***	14.403***
			(0.939)	(5.071)
Gross_wealth (log)			1.386***	-0.256

			(0.153)	(0.647)
Sex of HHead (Female=0)			-0.634	-15.441***
			(1.629)	(1.351)
Land (Arid and Semi-Arid=0)			2.239***	-4.721*
			(0.498)	(2.572)
Constant			11.320***	66.855***
			(2.541)	(12.034)
Observations	3,157	3,157	3,157	3,157

ATE= Average Treatment Effect (ATE) [the mean of the difference (Y₁ - Y₀)]

PO mean=Potential-outcome means (means of Y₁ and Y₀ in the population]

OME₀= Untreated potential-outcome equations

OME₁= Treated potential-outcome equations

*Robust standard errors in parentheses: *** p<0.01, ** p<0.05,*

6.2 Additional Determinants of Household Dietary Diversity Scores

6.2.1 Untreated potential-outcomes

The untreated potential outcomes refer to the outcome that a household would obtain if given no treatment. When not having access to organized markets, key determinants of HDDS include education of the household head, household wealth and potential of land across all the three estimations.

From the base of having no education, having at least primary, secondary and tertiary level of education improves HDDS by approximately 2.4, 4 and 3 points, respectively (Tables 3-5, column 3). On average, the highest educational benefits can be achieved when the household head has at least secondary education. The findings are comparable to that of Sibhatu and Qaim (2018) and Kassie et al., (2014) where education level of household head contributes to better household diets and probability of being food-secure.

Similar to the findings by Sraboni et al. (2014), having a household head who is self-employed, which mainly involves trade, improves HHDS by 1.52 points (Table 3, column 3) and 1.66 (Tables 5, column 3). In addition, HDDS improves by approximately 2.2 points in the high productive areas compared to the arid and semi-arid lands (Tables 3-5, column 3). Increased productivity, and thereby increased farm income, coupled with market access is likely to improve dietary diversity scores of households (Hirvonen and Hoddinott, 2014; Koppmair et al., 2017; Signorelli et al., 2017). Similarly, household wealth increases HDDS by approximately 1.4 points across all the three estimations (Tables 3-5, column 3).

On average, household wealth increases HDDS by 1.4 points (Tables 3 and 5, column 3) and 1.2 points (Table 4, column 3). Household size was found to

have a negative effect on HDDS. Increasing household sizes reduces HDDS by approximately 0.3 points (Tables 3-5, column 3). A high dependency burden is likely to exacerbate the effect of poor access to markets on dietary scores (Fischer and Qaim, 2012; Gaiha et al., 2014).

6.2.2 Treated potential-outcomes

Similar to the untreated potential outcomes, primary occupation of the household head significantly influences HDDS, but the effect is only observed when both the man and woman in a household have access to organized agricultural markets (Table 5, column 4). When primary occupation of the household is in formal salaried employment, HDDS on average reduces by about 9.1 points. This is likely due to the changing lifestyles and eating habits involving less healthy diets associated with these groups (Republic of Kenya, 2012).

Investment in education significantly influences HDDS where higher investment levels improve HDDS by about 14.4 points (Table 5, column 4). Sex of the household head, not surprisingly, had a significant impact on household dietary diversity scores. On average, male headship of households worsens HDDS by 13.91 points when evaluating for the effect of women's access to organized agricultural markets (Table 3, column 4). Further, HDDS are observed to be lower in male headed households by 5.02 points (Table 4, column 4) when evaluating the effect of men's access to organized agricultural markets and by 15.4 points (Table 5, column 4) when both the man and woman in a household have access to organized agricultural markets. As highlighted earlier, there exists intra-household resource flows where women are likely to spend more towards improving their households' food and nutritional incomes compared to men (World Bank et al., 2009). Expenditure on food items is, however, affected by who in the household makes decisions. Where men are in control, women may lose control of commodities, and thereby income when commodities become profitable (Njuki et al., 2011; Quisumbing and Pandolfelli, 2010) and thus the negative effect of the male headship on dietary diversity scores (Tables 3-5, column 4). The effect is observed to be least where men have access to organized agricultural markets (Table 4, column 4), compared to cases where women have access (Tables 3 and 5, column 4) further underscoring the importance of women's access to organized markets is likely to have on HDDS.

Among other factors, these results highlight gender differences in household dietary diversity scores and the importance of considering these differences in efforts towards improving access to markets for improved households' diets.

7. Conclusion and Policy Implications

This study adds to the literature on the role that gender sensitive approaches in agriculture play in promoting food and nutrition security in households. Gender considerations in efforts to increase the participation of farmers in organized agricultural markets have the potential of improving dietary diversity of households and thereby likely to have important implications for household's food and nutrition security. Our results indicate that improved access to well organized agricultural market systems for both men and women are likely to improve dietary diversity scores of households. However, the improvement of women's access has a greater effect; more than double that of men. The different gender effects can be attributed to the different spending patterns towards food and nutritional security between men and women, where women spending towards food and nutrition has been observed to be Pareto-superior to that of men. The crucial role played by women in household's dietary diversity scores is further emphasized by the negative effect of male headship in households.

Greater positive effects on household's dietary diversity scores are, however, observed where both men and women in households have access to well organized markets. The observed synergy when both women and men within the same household have access to organized agricultural markets underscores the need to take a whole family approach in market initiatives aimed at improving the quality of household diets. The zero-sum conceptualization of power within majority of households is likely to reduce the potential benefits on household diets when market initiatives target women only.

Additional factors having a positive impact on the dietary diversity include investment in education by the household head, household wealth and productivity of land farmed by households. Household size and engagement in formal employments are, however, found to negatively affect household's dietary diversity scores.

The results have important national policy implications. The country's Agricultural Sector Transformation and Growth Strategy (ASTGS) 2019-2029 aspires to deliver a vibrant commercial agricultural sector to support the country's development in areas such as achieving 100 per cent food and nutrition security and global commitments such as the SDGs. Towards achieving food and nutrition security, the results highlight the need for policy to enhance equitable access to markets by both men and women for optimal household dietary diversity. As such, barriers to effective participation of men and women in agricultural markets should be explicitly examined and recognized in policy. Secondly, while diet and nutrition related matters in the country fall under the Ministry of Health, the Ministry has

little to do with enhancing access to agricultural markets. Enabling services such as adequate market infrastructure, access to trading credit facilities and greater marketing channels, which are key for enhanced agricultural market access, are provided by different sectors of the economy. This highlights the need for cross-sector coordination to enhance market access and thereby household's capacity to tackle dietary and nutritional issues. The Kenyan National Food and Nutrition Security Policy Implementation Framework 2017-2022 endorses the creation of a multi-sectoral Food Security and Nutrition Secretariat to ensure broad, cross-sectoral implementation, coordination and monitoring mechanisms. However, this is yet to occur. It would be the task of such a committee to ensure that there are gender-sensitive solutions towards greater opportunities for both women and men opportunities to participate in organized agricultural markets.

The results also highlight presence of gender intra-household dynamics in household's dietary effects. Government efforts focusing on diet and nutrition improvement among rural households need to recognize the role of women's socio-economic power in contributing towards adequate diets at the household level. Specific recommendations towards women's greater socio-economic include, linking women to organized agricultural markets, investment in human capital, and greater opportunities to wealth creation. Further, on human capital, given the positive impacts of education on household dietary diversity scores, learning institutions can maximize returns to educational investments in both men and women by incorporating diet and nutrition education in schools. Education can be instrumental in achieving adequate awareness and knowledge on nutritionally adequate diets, and also acquiring the capacity to support diet and nutritional national programmes in the country.

The study recommends future analysis to assess gender-specific challenges in accessing new and advanced agricultural markets. The path to achieving improved household's dietary diversity scores must address the unique constraints and opportunities to enhance women's participation in organized markets by incorporating tailored solutions. In addition, analysis using a gendered spatial analysis approach to examine the effects of access to markets on other nutritional outcomes, such as anthropometric measures, may be needed to further exploit the market effects on access to nutritious food to meet households' dietary needs. In addition, we suggest that future analysis preferably using panel data may be carried out to control for unobserved heterogeneity.

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Appendix

Appendix Figure 1: Trend, projection and targets in the prevalence and number of children (under-five) stunted in Kenya



Source: *EU-Country Profile on Nutrition-Kenya*. European Commission, International Cooperation and Development: https://ec.europa.eu/europeaid/nutrition-map_en- July 2017

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