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Income diversification among female-headed farming households

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Abstract: In most rural parts of sub-Saharan Africa, production on one's own farm is still the main source of income. However, other sources are becoming more important and obtaining income from outside the agricultural sector has been identified as an important path out of poverty. To take advantage of these more attractive livelihood strategies, households need to overcome several barriers to entry. Female-headed households have been found to have less education, less productive resources, and less access to credit than male-headed households; thus, they have limited options.

Using data from the RIGA database, we analyze income diversification among female-headed households in rural Kenya. Using a multinomial logit model, we find that households headed by a married woman are approximately 12 percentage points more likely to rely only on income from their own farms compared to households headed by monogamously married man. Female-headed households are also less likely to diversify into non-agricultural wage work than male-headed households.

Keywords: Income diversification, Livelihood, Female-headed households, Kenya

JEL Classification: O12, O15, O55, J16

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1. Introduction

For the majority of rural households in sub-Saharan Africa, on-farm production is still the most important source of income. However, other sources have been growing, and the share of non-agricultural income is estimated to be approximately 35 percent (Reardon et al. 2007). Livelihood diversification has been shown to increase earnings (e.g., Barrett et al. 2005, Kristjanson et al. 2010, Freeman et al. 2004, Bigsten and Tengstam 2011, Hoang et al. 2014) and has been identified as an important way out of poverty. Livelihood diversification is also important for decreasing household vulnerability to shocks (e.g., Ellis 2000, Christiansen and Subbarao 2005) and can be viewed as a risk-coping strategy.

However, not everyone has access to these high-return activities. To take advantage of these more attractive livelihood strategies, households need to overcome barriers to entry, such as insufficient skills, contacts, and capital (Barrett et al. 2001a). These constraints are especially difficult for poor households to overcome but can also be linked to gender. Female-headed households may be constrained because they often are poorer and because they face special constraints due to gender. Generally, they have less education and less access to productive assets and credit, which both limit their options for diversification. Female-headed households might also be hindered by norms about female labor force participation.

In this paper, we analyze income diversification among female-headed households. Specifically, we examine (1) whether income among female-headed households is less diversified than in male-headed households, (2) whether female-headed households diversify their income differently than male-headed households, and (3) which factors determine how female-headed households diversify their income.

Compared to most previous research, which often focuses on specific sources of income, we analyze the full range of income-generating activities. Furthermore, our focus is on diversification at the household level. To the best of our knowledge, we are the first to conduct this type of analysis for female-headed households.

However, female-headed households represent a heterogeneous group with different reasons for becoming female-headed (e.g., Fuwa 2000, DeGraff and Bilsborrow 1993), and each type faces different constraints. Therefore, including only a dummy variable capturing the gender of the head of household may yield misleading results, and this approach has, for example, been shown to underestimate the risk of poverty (Rogan 2012). Furthermore, we find that dividing the group into households with married and unmarried heads is not sufficient. Instead, we

control for all types of marital status (monogamously married, polygamously married, divorced, widowed or never married). To the best of our knowledge, no previous work on income diversification has used this finer division. We also include information about male-headed households, which yields important insights about income diversification in general. In contrast to earlier studies conducted in Kenya, which have focused on specific groups or regions (e.g., Olale and Henson 2012, 2013, Ilyama et al. 2008, Lay and Mahmoud 2008, Freeman et al. 2004, Barrett et al. 2001b), we use nationally representative data.

Using a multinomial logit model, we find that households headed by a married woman are approximately 12 percentage points more likely to rely only on income from their own farms compared to households headed by a monogamously married man. Households headed by a married female are also less likely to participate in non-agricultural wage labor and non-farm self-employment.

The remainder of this paper is organized into five sections. Section 2 discusses the reasons for diversification and the special constraints faced by female-headed households. Section 3 presents the data, and section 4 elaborates the empirical strategy. Section 5 provides the results, and section 6 concludes.

2. Why do households diversify?

In the analysis of income diversification, the theoretical foundation is often provided by the farm household economic model (Hymer and Resnick 1969, Huffman 1980). In this model, the household is considered a single decision-making unit that maximizes its utility by choosing among a set of income-generating activities, given certain constraints. The household can rely only on the production of its own farm or can diversify its income sources.

Livelihood diversification can occur out of necessity or by choice (Ellis 2000). Diversification out of necessity refers to situations in which the income from the household's farm production is not enough to sustain an acceptable standard of living. Diversification by choice refers to voluntary reasons for diversification, which often linked to the desire for higher returns from off-farm activities. Having different income sources can also be considered a risk-coping strategy because diversified households are less vulnerable to economic shocks than undiversified households (Ellis 2000). In Kenya, increasing access to non-farm employment has been identified as an important approach to reducing household vulnerability (Christiansen and Subbarao 2005).

2.1 Livelihood diversification strategies

To capture different forms of diversification, it is important to consider not only whether a household has a diversified income portfolio but also *how* it diversifies. Households can obtain earned income from four different sources: their own farm, other farms, non-agricultural wage work, and non-farm self-employment.[2]

Some households rely on farming their own land and raising their own animals. This group generally consists of two types of households. First, there are poor households without access to the labor market, which have no choice but to rely on their own production for survival. Second, there are households with high-quality land endowments and adequate market access for which this livelihood strategy can yield relatively high returns. Because this approach requires sufficient access to land, it is not possible for many poor households, which can instead diversify into earning wages by working on other farms, an option that does not require schooling and is accessible to individuals without an education.

If a household is able to diversify into off-farm wage labor, this will generally offer a higher return. Off-farm labor will also provide more effective insurance against shocks because it is less correlated with the production of the household's farm. However, there is also considerable diversity in terms of returns within the non-farm sector. Because of high entry barriers, we expect relatively wealthy households to dominate higher-return non-farm activities (Woldenhanna and Oskam 2001). Households can also choose to diversify into non-farm self-employment. However, starting a business generally requires some capital, and if a household lacks the resources it needs, it has to borrow.

It is important to note that different income-generating activities cannot be viewed in isolation, as they are connected through investment, production and consumption. For example, income from wage labor can be used to purchase equipment, which can increase the productivity of the farm (Davis et al. 2009). Stampini and Davis (2009) show that income from non-agricultural wage work helps households overcome the credit constraints faced in farming, and households that participate in non-agricultural wage work spent more on inputs for farming. In the same sense, Oseni and Winters (2009) show that households in Nigeria use income from non-farm work to purchase inputs for crop production.

[2] Furthermore, households can also choose to diversify within the farm by farming different types of crops, livestock, etc. In Kenya, Githinji et al. (2014) found that female-headed households were less likely to grow cash crops than male-headed households. However, within-farm diversification is beyond the scope of this paper.

2.2 Female-headed households and livelihood diversification

The female-headed household's diversification options will be determined by the specific constraints linked to gender. In this section, we will discuss the situation of the female-headed household in relation to labor, land, human capital, credit and gender norms.

Because female-headed households are generally smaller, they sometimes lack sufficient labor to diversify their income sources. In addition to labor, female-headed households, and women in general, have less access to productive resources. In his seminal paper about gender differentials in farm productivity, Udry (1995) shows that the productivity of plots farmed by women is lower than that of plots farmed by men because less productive resources are allocated to plots controlled by women. Furthermore, while women are also less likely to own land, those who do often own plots that are smaller and lower quality than those owned by men. In 9 of 14 countries (in the RIGA database), landholdings were smaller among female-headed households than among male-headed households (FAO 2011). Formal law in Kenya allows women to both inherit and buy land. However, land rights are also regulated by customary law, which has been known to discriminate against women. According to these laws, only men can own land, and women instead obtain access to land through their relationship to men. According to formal law, a woman can inherit land, but when she dies, that land cannot be included in her will. If a woman re-marries, she has no longer any right to the land of a deceased husband. How women are treated by customary law varies, and some laws do not allow women to inherit at all, while others do (Harrington 2010).

In addition to lack of access to productive resources, female-headed households sometimes lack access to credit. This is especially important if the household wants to diversify into self-employment. In the above-mentioned survey, rural, female-headed households were less likely to use credit in seven of nine countries (FAO 2011). Reardon (1997) concludes that women are sometimes limited to businesses with low start-up costs.

Furthermore, access to high-return off-farm wage employment requires a certain level of human capital (e.g., Escobal 2001, Woldehanna and Oksam 2001, Senadza 2012, Bigsten and Tengstam 2011). Although the gender gap in education has decreased in most developing countries, female heads of household generally have lower levels of education than their male counterparts (FAO 2011). They might also lack the connections needed to access these forms of employment, and sometimes, social norms regarding female labor force participation hinder women from entering the labor market (Mammen and Paxon 2000). In Kenya, the gender gap

in education has narrowed, and in 2012, there were as many girls as boy in primary education. However, in secondary education, only 93 girls were enrolled for every 100 boys (World bank data).

Because of the special constraints faced by women, we expect that female-headed households are less likely to report off-farm wage work or to operate their own business than male-headed households. Because we believe that female-headed households face constraints that reduce the probability of diversifying into off-farm activities, we expect them to be more reliant on the agricultural sector, farming full time and diversifying into on-farm wage labor.

However, female-headed households are a heterogeneous group with different reasons for becoming female-headed. In households where there is a man present, he may be able to help the household to overcome some of the constraints listed above. Even if the man does not live in the household (for example a husband living elsewhere because of work), he might help the family with access to productive resources such as land and credit.

Previous research has also found that women and men differ in degree of risk aversion, which could influence their optimal level of diversification. Eckel and Grossman (2008), and Croson and Gneezy (2009) summarize a large amount of research and conclude that evidence from field studies generally show that women are more risk averse than men. This finding is supported by evidence from experiment-studies, while the evidence from contextual environment is more mixed. However, most of these studies are conducted in developed countries. If this hold also in our setting, we would expect female-headed households to demand higher levels of diversification than male-headed households.

2.3 Previous studies

To the best of our knowledge, the paper closest to ours is Djurfeldt et al. 2013, which looks at differences in farm and non-farm income between male- and female-headed households. Although their focus is somewhat different from ours, mainly focusing on discrimination in income levels (in eight African countries), they have some conclusions that are relevant for our study. Comparing income levels between 2002 and 2008 they find that households that diversified out of agricultural work have higher incomes than others, and participation in the non-farm sector is related to higher incomes. They also find some evidence that female-headed households are more likely to obtain income from both farm and non-farm sources. However, looking at the share of households with access to non-farm incomes in Kenya, they do not find any statistically significant difference between female and male head households.

Although female-headed households are not the main interest of most previous research, the gender of the head of household is often included as a control variable. The results from these studies are mixed, with some finding that female-headed households are less likely to diversify (e.g., Block and Webb 2001) and others finding no impact (e.g., Escobal 2001). Bigsten and Tengstam (2011) find that female-headed households are less likely to diversify into non-agricultural waged work and are more likely to diversify into business. Barrett et al. (2005) find that female-headed households in Rwanda are more dependent on unskilled labor than are male-headed households. Senadza (2014) finds that female-headed households in Ghana are more likely to combine their farming activities with self-employment. However, these studies are limited by the fact that they treat female-headed households as a homogeneous group, without considering the diverse circumstances that lead being female-headed.

In Kenya, Kassie et al. (2014) found that female-headed households whose head was single, widowed, divorced or separated face higher probabilities of food insecurity than female-headed households whose head was married but the husband lives elsewhere. They also found and that different variables explain food security in these two groups.

3. Data

The income statistics used in this paper come from the RIGA database, which is a joint project between the Food and Agriculture Organization of the United Nations (FAO) and the World Bank to produce aggregated income data are comparable across countries.[3] Using these data increases the comparability of our results with those of other studies/countries using the RIGA data. For Kenya, the data are aggregated from the Kenya Integrated Household Survey (KIHBS) 2005/06. This survey was conducted by the Kenya Bureau of Statistics from May 2005 to May 2006. It contains 13,430 randomly selected households from all districts in Kenya, which are divided in 861 rural and 482 urban clusters. The sample is representative at the national, urban/rural, provincial, and district levels. The RIGA data were merged with the underlying KIHBS data to yield further insights into differences in income diversification.[4]

The income data are divided into wages (from agricultural or non-farm work), non-farm self-employment, agricultural production, transfers, and other income. Total income for household *i* is given by

[3] http://www.fao.org/economic/riga/en/

[4] For more detail about how the aggregate data were calculated, see Covarrubias et al. (2009).

$$TotY_i = Agewage_i + Nonagwage_i + Agricultural_i + Selfemp_i + Transfer_i + Other_i$$

All aggregates are calculated at the household level and annualized. The estimates are based on regular and/or recurring income sources and expenditures. Wage employment is disaggregated by industry following the United Nations International Standards and Industrial Classification of All Economic Activities (ISIC). Industries are classified into 1) Agricultural, Forestry and Fishing, 2) Mining, 3) Manufacturing, 4) Utilities, 5) Construction, 6) Commerce, 7) Transportation, Communication and Storage, 8) Finance and Real Estate, 9) Services and 10) Miscellaneous. These categories are then aggregated into non-agricultural (2-10) and agricultural (1) wages. Earnings from wage employment are net and include all in-cash and in-kind benefits received from employers. Income from agricultural production can be divided into crop and livestock production. Crop production includes sales of crops (and crop by-products), sharecropping earnings, and consumption of homegrown crops. Livestock production includes the sale and barter of livestock, livestock by-products and household consumption of such products. Following the ILO's International Standard Classification of Occupations (ISCO-88), the wage is further divided into skilled, unskilled, and unknown categories. Income is net of all expenses. Non-farm self-employment is work in an enterprise owned by any member of the household that is not directly connected to the household's agricultural production. Transfers are reported as gross figures and can be divided into private and public transfers. Private transfers are mostly remittances but can also be transfers from private organizations and associations or gifts. Social transfers consist of pensions and social benefits (Covarrubias et al. 2009).[5]

We are interested in the income diversification of farming (rural) households. A household was defined as rural if it was located in a rural part of the country. However, a rural household could still report a job in an urban setting. After we cleaned the data, we obtained a final sample of 6969 households of which 2068 (30 percent) were headed by a woman.

[5] Because income is calculated as the net value, it is possible that income from self-employment and/or agricultural production is negative. This makes it possible that income shares may be negative or larger than the 1. 6 percent of households that reported negative total incomes. If the share from any income source was larger than 300 percent or smaller than -300 percent, the observation was excluded.

3.1 Female-headed households

Our definition of female-headed household comes from self-reported information in the survey.[6] Of the female-headed households, 1202 were headed by a woman who was divorced, widowed or never married, while 866 were headed by a married woman (Table 1).

Table 1, Marital status by gender of head, n = 6969

	Female head n = 2068		**Male head** n = 4901	
	%	Observations	%	Observations
Monogamously married	30.22	625	79.47	3895
Polygamously married	11.65	241	15.32	751
Divorced	6.38	132	1.53	75
Widowed	47.78	989	1.94	95
Never married	3.92	81	1.73	85

Unweighted sample data

In the group of female-headed households, the largest group was headed by a widow (48 percent). In the group of married-female-headed households, 28 percent were polygamous and 72 percent were monogamous households.

A polygamous household is one in which a man takes several wives. In Kenya, having several wives is an indication of wealth.[7] In the survey, approximately 10 percent of the household heads stated that they were polygamously married. This tradition varies by groups and locations; 22 percent of the household heads in the Northeastern province stated that they were polygamously married, while the respective number in the Central province was 2 percent. When wives live in separate dwellings within the same compound or nearby, share housekeeping arrangements and have a common household budget, they are defined as a single household. However, if this is not the case, they are defined as separate households. Among the female-headed polygamous households, 77 percent stated that they did not live with their husband.

Monogamous households are those in which two persons are married only to each other. Among the monogamously married female-headed households, 80 percent stated that they did not currently live with their husband. A household is defined as individuals who live in the same compound, answer to the same head, and share a common source of food and/or income.

[6] Fuwa (2000) discusses alternative ways to define female-headed households, for example, based on earned income.

[7] In 2014, the parliament passed bill allowing a man to take as many wives as he wants, without consulting his current partner.

An individual who has been away from the household for more than nine months during the last year is not counted as a member. Therefore, a husband who has migrated for work is not counted as a household member, and these households fall into this group. Thus, we expect transfers to be important income sources for households with a monogamously married female head. Table 2 presents socioeconomic characteristics for the different groups.[8]

Table 2, Socioeconomic characteristics, n = 6969. Mean and standard error

	Female headed households				
	Monogamously married	Polygamously married	Divorced	Widowed	Never married
	n = 625	n = 241	n = 132	n = 989	n = 81
Age of head of household	38.34	46.38	44.30	54.58	39.33
	(0.56)	(1.17)	(1.24)	(0.55)	(1.37)
Years of education, head of household	6.35	3.36	3.92	2.88	6.96
	(0.20)	(0.32)	(0.42)	(0.16)	(0.53)
Household size	5.06	5.48	4.44	4.98	3.97
	(0.09)	(0.19)	(0.32)	(0.09)	(0.22)
Male labor	0.82	0.99	0.63	1.05	0.57
	(0.05)	(0.08)	(0.09)	(0.04)	(0.11)
Female labor	1.55	1.65	1.75	1.51	1.50
	(0.04)	(0.07)	(0.13)	(0.04)	(0.11)
Land/labor ratio	1.59	1.91	1.27	1.55	0.99
	(0.37)	(0.76)	(0.61)	(0.32)	(0.23)
Credit constraint	0.35	0.48	0.50	0.45	0.41
	(0.02)	(0.04)	(0.05)	(0.02)	(0.06)
Expenditures	26090.22	18617.01	21775.63	22016.77	31989.38
	(1523.21)	(971.57)	(1541.7)	(652.50)	(3846.60)
	Male headed households				
	Monogamously married	Polygamously married	Divorced	Widowed	Never married
	n = 3895	n =751	n = 75	n = 95	n = 85
Age of head of household	44.79	53.72	42.97	60.20	28.08
	(0.28)	(0.65)	(1.04)	(1.48)	(1.18)
Years of education, head of household	6.93	4.32	5.77	3.92	7.08
	(0.09)	(0.21)	(0.66)	(0.61)	(0.44)
Household size	5.79	6.79	2.65	4.14	1.73
	(0.06)	(0.15)	(0.32)	(0.26)	(0.19)
Male labor	1.49	1.54	1.32	1.34	1.28
	(0.02)	(0.05)	(0.08)	(0.13)	(0.08)
Female labor	1.45	1.67	0.26	0.81	0.18
	(0.02)	(0.05)	(0.07)	(0.10)	(0.05)
Land/labor ratio	0.92	1.18	1.17	1.33	1.05
	(0.04)	(0.17)	(0.18)	(0.19)	(0.27)
Credit constraint	0.40	0.48	0.54	0.48	0.36
	(0.01)	(0.02)	(0.07)	(0.06)	(0.05)
Expenditures	24057.30	18089.50	35474.31	28356.46	48804.30
	(605.71)	(636.37)	(3255.1)	(3014.06)	(5167.64)

Weighted data

[8] To gain a better understanding of the different situations of female-headed households, we would also have liked to know how long the households had been headed by women. Unfortunately, this information is not available in the data.

Earlier research has shown that female heads of household have lower levels of education than male heads of household (FAO 2011). This is true, on average, for all groups of female heads of household, except those who have never been married. We also find considerable variation within the group of married female heads of household, where the monogamously married group has, on average, six years of education, while the corresponding polygamously married group has three years of education. We further find that households headed by a polygamously married female are poorer than other households, while those headed by a never-married female are richer. It should be noted that some of these differences may be explained by the circumstances that lead the household to be female-headed in the first place. For example, if a man has a higher probability of death in a poor household, this makes the wife both a widow and a head of household.

3.2 Income sources

Next, we wish to know where female-headed households obtain their income. Therefore, Table 3 shows the breakdown of total income by the income source. Because our focus is on income diversification at the household level, we report these data as the mean of shares.[9]

[9] This is done by first calculating the income shares for each household and then calculating the means of these shares for each income source. An alternative would be to calculate the share of means, which show the importance of a specific source to the overall agricultural economy.

Table 3, Distribution of income by source. Mean (mean of shares) and standard error. n =6969

	Female Head				
	Monogamously married	Polygamously married	Divorced	Widowed	Never married
	n=625	n=241	n=132	n=989	n=81
Farm	46.39	54.92	47.31	47.52	36.76
	(2.15)	(3.36)	(6.15)	(1.87)	(7.48)
Agricultural wage	4.93	4.07	16.71	5.31	18.01
	(0.84)	(1.23)	(6.43)	(0.68)	(4.98)
Agricultural total	**51.32**	**58.99**	**64.02**	**52.84**	**54.77**
	(2.18)	**(3.32)**	**(5.43)**	**(1.80)**	**(7.57)**
Non-agricultural wage	8.11	6.16	12.80	9.39	7.71
	(1.04)	(1.43)	(3.19)	(1.01)	(2.85)
Non-farm self-employment	4.96	6.00	6.56	7.48	12.48
	(0.97)	(1.68)	(2.26)	(1.02)	(3.85)
Transfer	31.72	26.38	16.32	27.48	20.72
	(1.92)	(2.79)	(3.61)	(1.48)	(4.73)
Other	3.88	2.47	0.29	2.81	4.31
	(0.57)	(0.82)	(0.15)	(0.54)	(3.94)
Non-agricultural total	**48.68**	**41.01**	**35.97**	**47.16**	**45.23**
	(2.18)	**(3.32)**	**(5.43)**	**(1.79)**	**(7.57)**
	Male head				
	Monogamously married	Polygamously married	Divorced	Widowed	Never married
	n= 3895	n=751	n=75	n=95	n=85
Farm	50.77	55.21	42.06	58.66	40.57
	(1.11)	(1.97)	(6.46)	(5.13)	(5.90)
Agricultural wage	6.56	3.23	13.31	3.69	17.91
	(0.54)	(0.69)	(5.12)	(1.47)	(5.92)
Agricultural total	**57.33**	**58.44**	**55.37**	**62.35**	**58.48**
	(1.03)	**(1.91)**	**(5.46)**	**(5.00)**	**(5.47)**
Non-agricultural wage	16.19	12.50	15.29	11.06	21.21
	(0.87)	(1.38)	(4.25)	(3.11)	(4.59)
Non-farm self-employment	10.91	10.14	11.04	9.80	4.13
	(0.76)	(1.33)	(3.42)	(4.06)	(2.11)
Transfer	13.91	16.26	15.63	15.82	13.38
	(0.63)	(1.23)	(4.27)	(3.04)	(3.30)
Other	1.66	2.66	2.67	0.97	2.80
	(0.18)	(0.56)	(1.29)	(0.47)	(1.06)
Non-agricultural total	**42.67**	**41.56**	**44.63**	**37.65**	**41.52**
	(1.03)	**(1.91)**	**(5.46)**	**(4.99)**	**(5.47)**

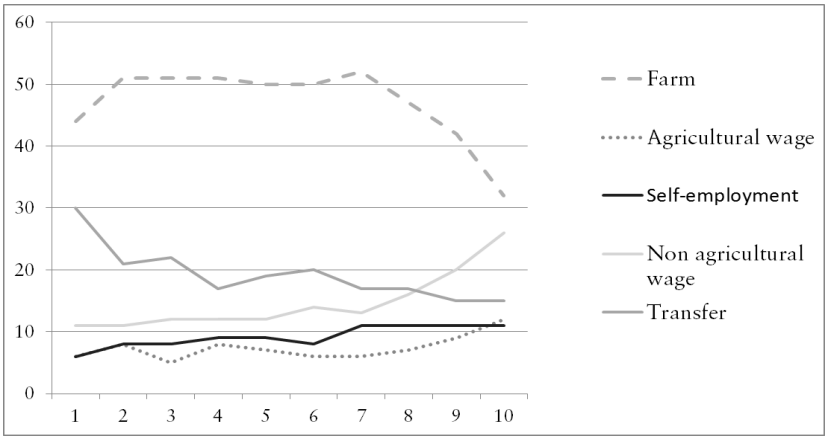
Weighted data

In line with previous research (e.g. Barrett et al. 2001b), we find that most households diversify their income. On average, households obtain 45 percent of their income from the non-agricultural sector. Although it is somewhat larger, this estimate is in line with earlier research from Kenya (Jayne et al. 2003) whose 1997 figures showed that non-farm income represented 40 percent of total rural household income. Compared to the African countries analyzed by Davis et al. (2010), it seems that households in Kenya obtain larger portions of their incomes from the non-agricultural sector (Malawi, 23 percent; Madagascar, 23 percent; Ghana, 39 percent; Nigeria 20, percent). However, with the exception of Ghana, Kenya is at a higher level of development than these countries. In the non-agricultural income category, non-agricultural wages and transfers are the most important sources. This is in line with the data presented in Reardon (1997) showing that in Kenya, earnings from non-farm wage labor were more important than income from self-employment. Transfers are more important for all groups of female-headed households than for male-headed households, and they represent a large portion of total income.

On average, male-headed households obtain a larger part of their total income from agriculture than female-headed households. However, there is diversity within the group of female-headed households, with income from agriculture representing 51 percent of the income received by households with a monogamously married female head but 59 percent for households headed by a polygamously married female. The reason why female-headed households obtain such large portions of their incomes from non-agricultural activities is that much of their income is received as transfers. Most reliant on income from transfers are female-headed households with monogamously married heads, with 32 percent of income coming from transfers. Most of these households stated in the survey that they received transfers from an individual. This pattern is expected because some of these women have husbands who have moved away for work and send money transfers home.

Examining the sources of income by income decile shows that when income increases, the proportions of income from one's own farm production and from transfers decrease (Figure 1). The proportion of income obtained from non-agricultural wages increases with income.

Figure 1, Income source and share, by income decile



Source: Own computation

Although this simple correlation does indicate a causal relationship, it supports the view that entering non-agricultural waged work provides an important path out of poverty.

4. Empirical strategy

This paper addresses different aspects of income diversification. Therefore, several methods are used in the analysis.

4.1 Level of diversification

There is no consensus in the literature about how the level of income diversification should be measured. Therefore, in this paper we use several measures: number of income sources (total and per adult) and percentage of total (earned) income obtained from non-agricultural sources.

We will also analyze what determines the number of income sources. To do this, we need a model that can address count data. The most commonly used model for this purpose is the Poisson regression model. However, this model is only suitable when the variance is equal to the mean (equidispersion). Because our data have a variance smaller than the mean (underdispersion), a Poisson regression model could overestimate the standard errors, leading to misinformed inferences. Instead, we use a model based on the generalized Poisson distribution, which is suitable for analyzing count data with either underdispersion or overdispersion (Consul and Jain 1973). This model has greater power and is more effective than

the standard Poisson when analyzing underdispersed data (Harrison et al. 2012). The probability mass function of y_i is given by

$$f(y_i;\ \theta_i, \delta) = \frac{\theta_i(\theta_i+\delta y_i)^{y_i-1}e^{-\theta_i-\delta y_i}}{y_i!}$$

where $\theta_i = E(y_i|x_i) =$ exp$(x_i\beta)$, x_i is the vector of explanatory variables, and β represents the coefficients to be estimated. Because a count, by definition, cannot be negative, $\theta_i > 0$. The level of dispersion is determined by $max(-1, -\theta_i/4) < \delta < 1$. When δ= 0, there is equidispersion, producing the usual Poisson distribution. If $\delta < 0$, there is underdispersion, and if $\delta > 0$, there is overdispersion (Harrison et al. 2012).

4.2 Participation

To analyze the decision to participate in a specific income-generating activity, we use a probit model in which a household chooses to participate if the expected net utility is positive. This can be stated as a latent variable model:

$$y_i^* = x_i\beta + z_i\gamma + \varepsilon_i$$
$$y_i = 1 \quad \text{if} \quad y_i^* > 0$$
$$y_i = 0 \quad \text{otherwise.}$$

A household chooses to participate in an income-generating activity if the expected utility $y_i^* > 0$, and we observe $y_i = 1$. x_i includes the head of household's gender and marital status, which is categorized as monogamously married, polygamously married, divorced, widowed, or never married. z_i is the vector of control variables (presented in section 4.3). ε_i is a normally distributed error term with mean 0 and variance 1. The error terms are clustered at the district level.

4.3 Income diversification strategy

In addition to knowing whether a household participates in a specific activity, we are interested in their combinations of income sources. As stated before, we divide households into five groups based on their combination of income-generating activities: own farm only, own farm

$$Prob(income\ combinaton_i = j) = \frac{e^{\beta_{oj}+\beta_{Xj}X_i+\beta_{zj}z_i}}{1 + \sum_{k=1}^{5} e^{\beta_{oj}+\beta_{Xj}X_i+\beta_{zj}z_i}}$$

and agricultural wage, own farm and non-agricultural wage, own farm and self-employment, and mixed. This allows a model with five unordered alternatives, where the household is assumed to maximize its utility by choosing a combination of income-generating activities. We use a multinomial logit model to model the choice of income combinations, where the probability that household *i* has income combination *j* is given by

$$j = 0, 1,\ldots,5, \beta_0 = 0.$$

As above, x_i includes the gender and marital status of the head of household, and z_i is the vector of control variables. We cluster the error terms at the small community level (10 households per community).[10]

4.4 Variables explaining income diversification

When a household decides to diversify, different constraints determine the alternatives available. Our main interest is in the variable indicating the gender and marital status of the head of household. In addition, we focus on variables capturing gender-specific constraints. Several of these variables are likely endogenous. Although we will use numerous strategies to address this, we do not claim causality but interpret the coefficients simply as correlations.

Working solely on the farm requires a sufficient amount of land. The larger the household, the more land is required to absorb the labor supply. Woldenhanna and Oskam (2001) find that surplus labor is an important determinant of diversification into off-farm wage employment, and Bigsten and Tengstam (2011) find that households with more land per laborer are more likely to be full-time farmers and less likely to diversify into either non-agricultural wage labor or agricultural wage labor. However, if households only work on their own farms and thus buy or rent more land, the land/labor ratio becomes endogenous. Bigsten and Tengstam (2011) test IV probit approach with average land per laborer within the district as the instrument. They show that this only marginally changes the results and choose to use the multinomial logit without instrument instead. Using their potential instrument in our setting shows that it is relevant for explaining the land/labor ratio. However, we can only reject the hypothesis that the land/labor ratio is exogenous in the equation for full-time farmers.[11] Furthermore, in Kenya, there is considerable diversity in suitability for farming among different parts of the country.

[10] We use the small community level instead of the district level used in previous models, as using the district level in this multinomial setting would yield too few degrees of freedom.

[11] We do also conduct the same analysis using owned land instead of farmed land. However, this yields similar results, showing that the variable is endogenous in the equation for full-time farming.

Thus, we expect that the mean size farm per labor at district level not only influences the income diversification decision through the effect on land per labor at the household level but also by capturing a more general structure of the district. We argue that in our setting, the mean size farm per labor at district level should instead be used as an explanatory variable. As a robustness check, we also estimate our models without these variables (these results available upon request). This does not influence our results. Therefore, we choose to include the amount of land per laborer as an explanatory variable with the average land per labor at district level, being aware of that the variable should be interpreted cautiously. We also include the number of males and females aged 15-59 and the number of children in different age categories.

Entering the off-farm wage sector often requires a certain level of education (e.g., Janvry and Sadoulet 2001); therefore, the options available to a household will be dependent on their level of human capital. To control for this we include the highest level of education in the household and the years of education of the head of household.[12]

If the household wishes to diversify into self-employment, we expect the availability of credit to be important. Unfortunately, we do not have a direct measure of this. Instead, we use the households self-experienced credit constraints by creating a variable that indicates whether the household applied for a loan and was turned down or whether they did not even try to borrow because they believed they would be refused, that it was too expensive or too much trouble, that they did not have enough collateral, or that they did not know any lenders.

A household's possibilities for diversifying its income could be influenced by gender norms in general and opportunities for women to participate in the labor market in particular. This would influence not only female-headed households but also male-headed households because it would determine which members that had the option of participating in the labor market. To measure this, we could include the percentage of women participating in the labor market; however, a larger value could mean either that the social norms make female labor market participation acceptable or that the household is located in a district with a high demand for labor. Therefore, we divide the variable by the percentage of males participating in the labor market, creating a variable that can be viewed as a proxy for female labor force participation norms. This variable is calculated at the district level. There are two potential problems with

[12] If individuals believe that they need a high level of education to find a job in the labor market and thereby increase their education, then this variable is also potentially endogenous in the livelihood diversification model. However, finding a good instrument for education is difficult and there was no suitable candidate. Therefore, we need to be careful when interpreting this variable.

this variable. First, gender specific job opportunities may exist, and these opportunities may differ among districts. Second, women who want to participate in the labor market may move to districts with high female labor force participation rates. Approximately 5 percent of the households in our sample had at least one individual who stated that they had moved to a specific district (or to Kenya in general) because of a job transfer or to look for a job. To control for this reason, we re-estimate our models excluding these households. Furthermore, we re-estimate the model using an alternative measure of gender norms from the Afrobarometer. These data are from 2005 (round 3) and measure the rate of individuals in a district who agreed with the statement that women should have equal rights and receive the same treatment as men (instead of agreeing that women always have been subject to traditional laws and customs and should remain so).

Furthermore, the possibility to diversify into different income-generating activities will depend on where the household is situated. Different locations have varying degrees of market access, different labor market opportunities and suitability for farming. We include several variables to control for these characteristics at the district level: mean land per labor, mean wage (logged), percentage of adult who are employed, distance to market and mean expenditures (logged). Moreover, we include province dummies. However, because some individuals might have moved to a specific district/province to obtain a job, start a business or buy land to farm, we re-estimate our models excluding these households (approximately 10 percent of the households in our sample). For definitions of the explanatory variables, see Table A.1 in the Appendix.

5. Results

5.1 Are female-headed households less diversified?

We start by examining whether female-headed households are less diversified than male-headed households. As discussed in part 4.1, we measuring the level of diversification by the number of income sources, total and per adult, and the percentage of earned income that comes from non-agricultural sources. In the remainder of this paper, we focus on earned income. Calculating the number of income sources, we find that households, on average, obtain earned income from 2.5 different sources (Table 4).[13]

Table 4: Level of diversification, n = 6969. Mean and standard error

	Female Head				
	Monogamously married n= 625	Polygamously married n=241	Divorced n= 132	Widowed n= 989	Never married n=81
Number of income sources	2.64	2.42	2.16	2.57	2.23
	(0.05)	(0.08)	(0.12)	(0.04)	(0.10)
Number of income sources per adult	1.54	1.25	1.21	1.38	1.37
	(0.05)	(0.07)	(0.08)	(0.04)	(0.10)
% from non-agricultural	18.67	14.10	24.70	20.78	22.56
	(1.99)	(2.53)	(4.95)	(1.61)	(4.63)
	Male head				
	Monogamously married n= 3895	Polygamously married n =751	Divorced n=75	Widowed n = 95	Never married n= 85
Number of income sources	2.57	2.58	2.31	2.35	2.05
	(0.02)	(0.05)	(0.12)	(0.09)	(0.13)
Number of income sources per adult	1.05	1.04	1.81	1.49	1.66
	(0.01)	(0.04)	(0.13)	(0.12)	(0.12)
% from non-agricultural	30.63	26.84	28.62	22.33	30.01
	(1.13)	(2.09)	(5.36)	(4.94)	(5.25)

Weighted data. All calculations are based on earned income only. % from non-agricultural is calculated as mean of shares

[13] There are 44 potential sources of income. We have information only about whether a household obtains income from a specific source. Therefore, if two individuals in the same household obtain their incomes from the same source, this will count as one income source for the household. Therefore, it is possible that we underestimate the total number of income sources.

We do not find clear differences in the total number of income sources between female- and male-headed households, but all types of female-headed households have (statistically significantly) more income sources per adult than households headed by monogamously married males.[14] This potentially reduces their vulnerability to economic shocks. However, how vulnerable a household is will also depend on how the income sources are linked to each other. A weather shock could, for example, affect production on their own farm as well as the possibility to obtain income from working on another farm. An alternative way to measure the level of diversification often used in the literature is the percentage of earned income that comes from outside the agricultural sector. We find that female-headed households, receive, on average, a smaller portion of their earned income from the non-agricultural sector compared to households headed by monogamously married males.

Estimating a generalized Poisson regression, including the control variables presented in Section 4.3, we find that having a monogamously married female head of household increases the number of income sources by a factor of 1.094 compared with having a monogamously married male head (Table 5).[15]

[14] However, comparing within marital status suggests a somewhat different story: female-headed households whose heads are divorced, widowed or never married have, on average, fewer income sources per adult than the respective group of male-headed households.

[15] The results are presented as incident-rate-ratios (IRR). An IRR of 0.6 means that the expected count is multiplied by a factor of .6 when the independent variable increases by one unit. Therefore, an IRR smaller than 1 indicates a negative effect on the expected count, while an IRR larger than 1 indicate a positive effect. The Results for control variables available upon request.

Table 5, Incident-rate-ratio, after generalized Poisson regression for number of income sources. With and without controls. Standard errors in parenthesis.
n = 6969

Constant	2.586	***	0.685	
	(0.047)		(0.365)	
Female head				
Monogamously married	1.031		1.094	***
	(0.023)		(0.019)	
Polygamously married	0.928	*	0.984	
	(0.037)		(0.031)	
Divorced	0.848	***	0.956	
	(0.033)		(0.029)	
Widowed	0.973	**	1.019	
	(0.015)		(0.016)	
Never married	0.828	***	0.909	***
	(0.029)		(0.026)	
Male head				
Polygamously married	0.993		1.034	*
	(0.028)		(0.021)	
Divorced	0.878	**	1.052	
	(0.046)		(0.084)	
Widowed	0.879	***	0.918	**
	(0.041)		(0.035)	
Never married	0.812	***	1.031	
	(0.048)		(0.059)	
Controls	No		Yes	
Dispersion	-0.496		-0.605	
Log pseudolikelihood	-6052770		-5676048	

Notes: *** 1% significance level, ** 5% significance level, * 10% significance level. Weighted data, standard errors clustered at district level.

5.2 Do female-headed households diversify differently?

In the previous section, we investigated whether female-headed households are more or less diversified than male-headed households. Now, we move on to our second question and analyze whether female-headed households diversify their incomes differently than male-headed households. We begin this section by examining the probability of participating in various income-generating activities (for descriptive statistics, see Table A.1 in the Appendix). We find that female-headed households, except when the head is divorced or widowed, are statistically significantly less likely to participate in non-agricultural wage labor than households headed by a male (Table 6). A household headed by a monogamously married female head is approximately 5 percentage points less likely to participate in non-agricultural wage work than a household headed by a monogamously married male. Both with and without the controls, a household with a divorced or never married female head has a higher probability of participating in agricultural wage work than a household headed by a monogamously married

male. Female-headed households whose head is married also have statistically significantly lower probabilities of participating in non-farm self-employment.[16] This result stands in contrast to previous research that has found that female-headed households are more likely to diversify into business (e.g., Bigsten and Tengstam 2011, Senadza 2014).

Table 6, Average marginal effects, Participation in income generating activities, Probit regressions, n = 6969

	Non-agricultural wage	Non-agricultural wage	Agricultural wage	Agricultural wage	Non-farm self-employment	Non-farm self-employment
Female head						
Monogamously married	-0.083 ***	-0.054 ***	-0.018	-0.003	-0.048 **	-0.061 ***
	(0.017)	(0.020)	(0.017)	(0.019)	(0.022)	(0.019)
Polygamously married	-0.130 ***	-0.094 ***	-0.009	0.012	-0.064 **	-0.075 ***
	(0.023)	(0.030)	(0.029)	(0.030)	(0.029)	(0.024)
Divorced	-0.066	-0.008	0.136 *	0.146 **	-0.083 **	-0.060
	(0.043)	(0.044)	(0.072)	(0.063)	(0.040)	(0.037)
Widowed	-0.070 ***	-0.017	-0.011	-0.002	-0.031 *	-0.018
	(0.017)	(0.020)	(0.012)	(0.012)	(0.018)	(0.018)
Never married	-0.137 **	-0.115 ***	0.122 **	0.099 *	-0.035	0.010
	(0.043)	(0.039)	(0.059)	(0.056)	(0.054)	(0.059)
Male head						
Polygamously married	-0.030	0.008	-0.042 **	-0.025	0.045	0.042 *
	(0.021)	(0.020)	(0.017)	(0.018)	(0.028)	(0.023)
Divorced	-0.042	0.015	0.040	0.021	0.002	0.045
	(0.064)	(0.082)	(0.048)	(0.046)	(0.050)	(0.054)
Widowed	-0.077 *	-0.020	-0.046	-0.049	-0.055	-0.012
	(0.042)	(0.051)	(0.032)	(0.031)	(0.050)	(0.063)
Never married	0.010	0.084	0.063	0.015	-0.137 ***	-0.106 **
	(0.063)	(0.067)	(0.053)	(0.045)	(0.038)	(0.047)
Log pseudolikelihood	-2384830	-2244216	-1643580	-1568520	-2250793	-2150276
Controls	No	Yes	No	Yes	No	Yes

Notes: *** 1% significance level, ** 5% significance level, * 10% significance level. Weighted data, standard errors clustered at district level.

[16] As a robustness check, we re-estimate the model including rural households that do not participate in farming. This makes the coefficient for a divorced female head statistically significant in the equation explaining participation in non-agricultural wage work when controls are not included. Furthermore, for the equation explaining participation in non-farm self-employment, the coefficient for a divorced female head becomes statistically insignificant when controls are not included. When controls are included, we do not find significant differences.

To better understand why a female-headed household might engage in different income-generating activities, we use a probit model to analyze the participation decision (Table 7).

Table 7, Average marginal effects, probit regression, participation in income-generating activities for female-headed households, n=2068

	Non-agricultural wage	Agricultural wage	Non-farm Self-employment
Polygamously married	-0.060 **	0.017	-0.028
	(0.030)	(0.029)	(0.035)
Divorced	0.035	0.143 **	-0.013
	(0.043)	(0.063)	(0.047)
Widowed	0.010	-0.002	0.020
	(0.025)	(0.019)	(0.024)
Never married	-0.044	0.099	0.071
	(0.049)	(0.066)	(0.071)
Age of head	0.002 *	-0.001	-0.000
	(0.001)	(0.001)	(0.001)
Years of education, head	0.008 *	-0.005 *	0.004
	(0.004)	(0.003)	(0.003)
Highest education in household	0.006	-0.002	0.005
	(0.004)	(0.003)	(0.003)
Male labor	0.045 ***	0.026 ***	-0.004
	(0.011)	(0.010)	(0.008)
Female labor	0.038 ***	-0.010	0.018 *
	(0.011)	(0.010)	(0.010)
Children aged 0-1	0.028	-0.044 ***	-0.002
	(0.019)	(0.013)	(0.017)
Children aged 2-5	0.008	0.018	0.020
	(0.012)	(0.015)	(0.016)
Children aged 6-10	-0.019 *	0.014	0.011
	(0.010)	(0.012)	(0.010)
Children aged 11-14	0.021	-0.010	0.004
	(0.013)	(0.012)	(0.013)
Credit constraints	-0.023	0.005	0.007
	(0.020)	(0.024)	(0.018)
Land per laborer	-0.001	0.000	-0.002
	(0.002)	(0.001)	(0.001)
Land in district	0.003	0.009 *	0.007
	(0.006)	(0.005)	(0.005)
Gender norms	0.030 **	0.013	-0.002
	(0.014)	(0.014)	(0.010)
Rate of wage labor	0.772 ***	0.660 ***	-0.003
	(0.063)	(0.242)	(0.221)
Distance to market	0.000	-0.000	0.002 ***
	(0.001)	(0.001)	(0.001)
Log mean wage in district	0.029	0.037	0.035
	(0.038)	(0.032)	(0.059)
Log mean expenditures in district	-0.008	0.145 ***	0.108 *
	(0.049)	(0.046)	(0.059)
Province dummies	Yes	Yes	Yes
Log Pseudolikelihood	-567841	-460173	-571698

Notes: *** 1% significance level, ** 5% significance level, * 10% significance level. Weighted data, standard errors clustered at district level. Comparison group for marital status is monogamously married.

We find that access to labor is important for explaining participation in non-agricultural waged work. Living in a district with a lower gap between female and male labor market participation increases the probability of a female-headed household participating, indicating that norms regarding female labor force participation are important. Re-estimating the model without households that have moved because of a job does not influence the result. However, the result is not robust to using a more general measure of gender norms. This could be an indication that either specific labor market participation norms matter or that our gender norms measure is endogenous.

Households with a polygamously married head have a statistically significantly lower probability of participation in non-agricultural wage work. For agricultural wage labor, however, a higher level of education decreases the probability that a household participates. Although the effect is small, it is in line with the view that households prefer to diversify into non-agricultural wage work if they can overcome the constraints.

5.3 Choice of income combination

In the previous section, we learned which income sources female-headed household use and how important they are. We now investigate how these households combine different income sources. As stated before, we combine households into five different groups depending on the sources from which they obtain their earned income: own farm only, own farm and agricultural wage, own farm and non-agricultural wage, own farm and self-employment, and mixed.[17]

We start by investigating how the gender and marital status of the head of household influence the income diversification strategy (Table 8).[18]

[17] We use a Wald test to see whether any of the groups can be combined. The result leads us to reject the hypothesis that any of the groups are indistinguishable.

[18] As a robustness check, we also estimate this model as five separate logit regressions. This only has a small impact on the results and does not change the overall conclusions (results available upon request).

Table 8, Average marginal effects after multinomial logit, with controls, n = 6969

	Own farm only	Own farm and agricultural wage	Own farm and non-agricultural wage	Own farm and self-employment	Mixed
Female head					
Monogamously married	0.116 ***	-0.008	-0.047 ***	-0.054 ***	-0.007
	(0.026)	(0.014)	(0.017)	(0.016)	(0.015)
Polygamously married	0.134 ***	0.027	-0.082 ***	-0.064 ***	-0.015
	(0.038)	(0.028)	(0.022)	(0.024)	(0.019)
Divorced	-0.078	0.135 **	-0.009	-0.036	-0.012
	(0.057)	(0.053)	(0.041)	(0.032)	(0.039)
Widowed	0.036	-0.006	-0.023	-0.014	0.007
	(0.024)	(0.013)	(0.018)	(0.016)	(0.014)
Never married	0.001	0.072 *	-0.059	-0.004	-0.010
Male head	(0.062)	(0.042)	(0.041)	(0.047)	(0.042)
Polygamously married	-0.010	-0.025 *	-0.010	0.022	0.023
	(0.026)	(0.014)	(0.020)	(0.018)	(0.018)
Divorced	-0.028	-0.032	0.033	-0.031	0.058
	(0.076)	(0.023)	(0.058)	(0.041)	(0.058)
Widowed	0.023	-0.029	0.015	-0.044	-0.053 *
	(0.064)	(0.023)	(0.049)	(0.053)	(0.027)
Never married	-0.007	0.017	0.127 **	-0.075 *	-0.063 ***
	(0.071)	(0.037)	(0.062)	(0.039)	(0.019)
Log pseudolikelihood	-5504143				

Notes: *** 1% significance level, ** 5% significance level, * 10% significance level. A discrete change from 0 to 1 for all variables except Gender norms, which shows the marginal effect of increasing the gap by one standard deviation. Standard errors of the changes in parentheses. Comparison group for headship status: monogamously married male head. Weighted data, standard errors clustered at the small community level.

Our results show that a female-headed household whose head is married has a higher probability of working only on their own farm and a lower probability of diversifying into non-agricultural wage work or self-employment than a household headed by a monogamously married male. Having a polygamous female head of household increases the probability that a household relies only on its own farm production by approximately 13 percentage points (compared to a household headed by a monogamously married male), while the respective number for households with a monogamously married female head is 12 percentage points. Households headed by divorced females have a 14 percentage points greater probability of combining work on their own farms with agricultural wage labor.[19] (For results without control variables, see Table A.2 in the Appendix).

[19] As a robustness check, we re-estimate the model including rural households that do not participate in farming. This makes the coefficient for having a monogamously or polygamously married female head statistically significant in explaining a mixed income diversification. In addition, having a divorced female head has a statistically significant negative effect on the probability of not participating in farming at all.

If we estimate the model for female- and male-headed households separately (Table 9), we find that marital status seems more important for female-headed than male-headed households (using monogamously married heads as the reference). A household with a divorced female head is approximately 20 percentage points less likely to rely only on the production of its own farm compared to a household whose female head is monogamously married.

Having one more adult (aged 15-59 years) in the household increases the probability of a female-headed household diversifying its income by approximately 3 percentage points, of it having a mixed income portfolio by approximately 2-3 percentage points, and of it diversifying into non-agricultural waged work by approximately 2 percentage points. The pattern is similar for male-headed households, but the magnitude is smaller. For these households, the amount of male labor seems more important for the income diversification strategy than the amount of female labor.

We do not find that self-reported credit constraints influence the diversification strategy. The amount of land per laborer seems to increase the probability of being a full-time farmer or of diversifying into self-employment. However, the effect is small and is only statistically significant for male-headed households. We are aware that this variable could be endogenous because households that want to specialize in agriculture might buy or rent more land.

For female-headed households, a smaller gap between female and male participation in the labor market seems to increase the probability of the household diversifying into non-agricultural wage work. Increasing this ratio by one standard deviation increases the probability of a female-headed household diversifying into non-agricultural wage labor by approximately 2 percentage points. However, consistent with our earlier result, this is not robust to changing the measure of gender norms. Re-estimating the model excluding households that moved to their current location to work or to buy land has only a minor impact on the results.[20]

[20] Results available upon request.

Table 9, Average marginal effects after multinomial logit divided by gender, n = 6969

	Own farm only	Own farm and agricultural wage	Own farm and non-agricultural wage	Own farm and self-employment	Mixed
Female headed households					
Polygamously married	0.038	0.048	-0.046 *	-0.021	-0.019
	(0.045)	(0.034)	(0.024)	(0.033)	(0.019)
Divorced	-0.190 ***	0.162 ***	0.039	0.014	-0.026
	(0.059)	(0.060)	(0.043)	(0.043)	(0.028)
Widowed	-0.045	0.006	0.014	0.033	-0.007
	(0.034)	(0.020)	(0.022)	(0.024)	(0.019)
Never married	-0.128 **	0.080	0.000	0.057	-0.008
	(0.064)	(0.052)	(0.046)	(0.060)	(0.038)
Age of head of household	0.000	-0.001 *	0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education, head of household	-0.007	-0.003	0.007 **	0.003	0.000
	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)
Highes education in household	-0.005	-0.003	0.003	0.003	0.002
	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)
Male labor	-0.035 **	0.01	0.021 **	-0.024 ***	0.029 ***
	(0.014)	(0.008)	(0.009)	(0.008)	(0.008)
Female labor	-0.028 **	-0.014	0.019 *	0.003	0.019 ***
	(0.013)	(0.010)	(0.010)	(0.009)	(0.007)
Children aged 0-1	0.012	-0.034 ***	0.029	-0.002	-0.005
	(0.024)	(0.011)	(0.018)	(0.016)	(0.012)
Children aged 2-5	-0.031 **	0.009	0.000	0.014	0.008
	(0.015)	(0.010)	(0.011)	(0.014)	(0.010)
Childrenaged 6-10	-0.003	0.012	-0.014	0.004	0.000
	(0.014)	(0.010)	(0.009)	(0.009)	(0.009)
Children aged 11-14	-0.016	-0.015	0.023 *	0.013	-0.005
	(0.017)	(0.010)	(0.013)	(0.012)	(0.009)
Credit contraint	-0.004	0.009	-0.004	0.013	-0.014
	(0.026)	(0.018)	(0.018)	(0.018)	(0.012)
Land labor ratio	0.002	0.000	0.000	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mean land labor ratio in district	-0.012	0.003	-0.001	0.004	0.006
	(0.009)	(0.006)	(0.005)	(0.004)	(0.005)
Gender norm	-0.029	-0.001	0.024 *	-0.006	0.012
	(0.018)	(0.012)	(0.013)	(0.012)	(0.009)
Rate of wage labor	-0.549 ***	0.17	0.258	-0.132 ***	0.252
	(0.019)	(0.403)	(0.453)	(0.010)	(0.473)
Distance to market	-0.001	0.00	-0.001	0.001	0.001 **
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log wage in district	-0.049	-0.007	-0.008	0.007	0.058
	(0.055)	(0.031)	(0.033)	(0.042)	(0.050)
Log mean expenditures	-0.187 ***	0.100 *	-0.044 *	0.046	0.085
	(0.056)	(0.059)	(0.027)	(0.058)	(0.069)

Table 9, continued

Male headed households

Polygamously married	-0.020		-0.026	*	-0.003		0.026		0.024
	(0.026)		(0.014)		(0.023)		(0.019)		(0.019)
Divorced	-0.024		-0.029		0.025		-0.033		0.061
	(0.077)		(0.024)		(0.063)		(0.044)		(0.058)
Widowed	0.012		-0.027		0.016		0.055		-0.055
	(0.065)		(0.023)		(0.054)		(0.057)		(0.031)
Never married	0.013		0.017		0.120	*	-0.080	**	-0.070
	(0.071)		(0.036)		(0.064)		(0.041)		(0.019)
Age of head of household	0.003	***	-0.001	***	0.000		-0.001	***	0.000
	(0.001)		(0.000)		(0.001)		(0.001)		(0.000)
Education, head of household	-0.007	**	-0.003	*	0.005	*	0.001		0.004
	(0.003)		(0.002)		(0.003)		(0.003)		(0.002)
Highes education in household	-0.011	**	-0.004	*	0.011	***	0.000		0.003
	(0.004)		(0.002)		(0.004)		(0.004)		(0.002)
Male labor	-0.015	*	0.007		0.011		-0.018	***	0.016
	(0.009)		(0.006)		(0.007)		(0.006)		(0.006)
Female labor	-0.015		-0.004		0.004		0.006		0.009
	(0.010)		(0.006)		(0.009)		(0.009)		(0.006)
Children aged 0-1	0.001		-0.003		-0.003		0.006		-0.001
	(0.015)		(0.009)		(0.012)		(0.012)		(0.009)
Children aged 2-5	-0.005		0.001		-0.015		0.012		0.007
	(0.011)		(0.007)		(0.010)		(0.008)		(0.007)
Children aged 6-10	-0.002		-0.019	***	0.006		0.010		0.005
	(0.009)		(0.005)		(0.008)		(0.008)		(0.006)
Children aged 11-14	-0.001		-0.007		-0.008		0.011		0.005
	(0.011)		(0.007)		(0.009)		(0.009)		(0.007)
Credit contraint	0.018		0.011		0.001		-0.012		-0.018
	(0.018)		(0.012)		(0.015)		(0.013)		(0.010)
Land labor ratio	0.009	*	-0.001		-0.012	*	0.005	*	-0.001
	(0.005)		(0.004)		(0.007)		(0.002)		(0.003)
Mean land labor ratio in district	-0.008		0.007		0.001		-0.005		0.004
	(0.007)		(0.005)		(0.006)		(0.004)		(0.004)
Gender norm	-0.033	**	-0.009		0.021		0.017		0.004
	(0.015)		(0.008)		(0.013)		(0.014)		(0.007)
Rate	-0.459	***	-0.082	***	0.379		-0.148	***	0.310
	(0.011)		(0.010)		(0.351)		(0.023)		(0.352)
Distance to market	0.002	*	-0.001	**	0.000		0.000		0.000
	(0.001)		(0.001)		(0.001)		(0.001)		(0.000)
Log wage in district	-0.025		-0.006		0.038		0.015		-0.021
	(0.047)		(0.022)		(0.041)		(0.037)		(0.021)
Log mean expenditures	-0.102	**	0.236	***	-0.087	***	-0.019		-0.027
	(0.047)		(0.061)		(0.022)		(0.039)		(0.018)

Notes: *** 1% significance level, ** 5% significance level, * 10% significance level. Discrete change from 0 to 1 for all variables except Gender norms, which shows the marginal effect of increasing the gap by one standard deviation. Standard error of change in parentheses. Weighted data, standard errors clustered at the small community level.

Conclusion

Non-agricultural income has been shown to increase earnings, and diversification has been identified as an important way out of poverty. Income diversification can also be used as a risk-coping strategy because it reduces a household's vulnerability to shocks. However, not everyone has access to high-return activities. Female-headed households have been found to have less education, less productive resources, and less access to credit than male-headed households, limiting their options for livelihood diversification.

Using data from the RIGA database, we analyze income diversification among female-headed households in Kenya. Specifically, we examine (1) whether the income of female-headed households is less diversified than that of male-headed households, (2) whether female-headed households diversify their income differently to male-headed households, and (3) which factors determine how female-headed households diversify their income.

In general, Kenyan households seem to diversify their income, with approximately 45 percent coming from outside the agricultural sector. Examining total income, we find that female-headed households receive large portions of their incomes from transfers than male-headed households (28 percent, on average, compared to 14 percent for male-headed households). If we instead focus on earned income, we find that female-headed households are, in general, more dependent on the agricultural sector than male-headed households. Female-headed households (except divorced heads) obtain larger parts of their earned incomes form the agricultural sector.

Households with married female heads have about 12 percentage points higher probabilities of being full-time farmers than male-headed households, and they are less likely to combine farming with non-agricultural wage work or non-farm self-employment. Because non-agricultural wage work has been identified as a way out of poverty, it is important to consider how female-headed households can access these activities.

Furthermore, we do find that income diversification strategies differ among groups of female-headed households. Therefore, we argue that it is important for future research to not only consider the gender of the head but also account for all marital statuses.

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Appendix

A.1 Variable definition and sample statistics

Variable	Definition
Dependent variables	
Own farm only	Household obtains all income from work on own farm
Own farm and agricultural wage	Household obtains income from work on own farm and agricultural waged work
Own farm and non-agricultural wage	Household obtains income from work on own farm and non-agricultural waged work
Own farm and self-employment	Household obtains income from work on own farm and non-farm self-employment
Mixed	Household has more than two income sources
Characteristics of head	
Female head:	
Monogamously married	Head of household is female and monogamously married
Polygamously married	Head of household is female and polygamously married
Divorced	Head of household is female and divorced
Widowed	Head of household is female and widowed
Never married	Head of household is female and never married
Male head:	
Monogamously married	Head of household is male and monogamously married
Polygamously married	Head of household is male and polygamously married
Divorced	Head of household is male and divorced
Widowed	Head of household is male and widowed
Never married	Head of household is male and never married
De jure female head	Head of household is a female who is separated, divorced or has never married
De facto female head	Head of household is a female who is married or living with a man with whom she is in a relationship
Age of head	Age of head of household
Education of head	Years of education for head of household
Characteristics of household	
Highest education	Highest level of education in the household
Male labor	Number of males aged 15-59 in the household
Female labor	Number of females aged 15-59 in the household
Children 0-1	Number of children aged 0-1 in the household
Children 2-5	Number of children aged 2-5 in the household
Children 6-10	Number of children aged 6-10 in the household
Children 11-14	Number of children aged 11-15 in the household
Land labor ratio	Area of plot/individuals aged 15-59
Characteristics of district	
Gender norm	Percentage of women aged 15-59 working for a wage/ percentage of men aged 15-59 working for a wage. Excluding the observation itself
Mean plot size, district	Mean area of plot, by district. Excluding the observation itself
Log(mean wage)	Mean wage in district (logarithm)
Expenditures district	Mean per capita expenditures in district (logarithm). Excluding the observation itself
Province	
Central	Household lives in the central province

Coast	Household lives in the coastal province
Eastern	Household lives in the eastern province
Northeastern	Household lives in the northeastern province
Nyanza	Household lives in Nyanza province
Rift Valley	Household lives in the Rift Valley province
Western	Household lives in the western province

A.2 Average marginal effects after multinomial logit, without controls, n = 6969

	Own farm only	Own farm and agricultural wage	Own farm and non-agricultural wage	Own farm and self-employment	Mixed
Female head					
Monogamously married	0.130 ***	-0.012	-0.063 ***	-0.033 *	-0.022 *
	(0.025)	(0.013)	(0.016)	(0.017)	(0.012)
Polygamously married	0.173 ***	0.010	-0.102 ***	-0.051 *	-0.030 *
	(0.038)	(0.025)	(0.018)	(0.027)	(0.016)
Divorced	-0.033	0.151 **	-0.039	-0.040	-0.039
	(0.058)	(0.064)	(0.037)	(0.035)	(0.027)
Widowed	0.096 ***	-0.009	-0.057 ***	-0.015	-0.015
	(0.022)	(0.012)	(0.015)	(0.015)	(0.011)
Never married	0.010	0.116 **	-0.069 *	-0.020	-0.037
	(0.064)	(0.051)	(0.040)	(0.042)	(0.029)
Male head					
Polygamously married	0.041	-0.039 ***	-0.040 **	0.026	0.012
	(0.026)	(0.012)	(0.017)	(0.019)	(0.016)
Divorced	0.022	-0.007	0.007	-0.044	0.023
	(0.067)	(0.033)	(0.047)	(0.038)	(0.042)
Widowed	0.114 *	-0.027	-0.030	-0.004	-0.061 ***
	(0.061)	(0.025)	(0.039)	(0.044)	(0.023)
Never married	-0.018	0.102 *	0.073	-0.081 **	-0.075 ***
	(0.064)	(0.055)	(0.050)	(0.034)	(0.012)
Log Pseudolikelihood	-5816908				

Notes: *** 1% significance level, ** 5% significance level, * 10% significance level. Discrete change from 0 to 1. Standard error of change in parentheses. Weighted data, standard errors clustered at the small community level.