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Women's Employment in Rural Senegal: What Can We Learn from Non-Farm Diversification Strategies?

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Abstract

As rural non-farm activities grow in developing countries, less attention is paid to the opportunities they may provide for women. We build on this perspective by examining the gender-differentiated impact of non-farm diversification strategies in rural Senegal. While non-farm diversification is a male-dominated livelihood strategy, rural women make the most of it, regardless of whether they diversify into low- or high-return, non-farm activities. At an individual level, diversification improves rural women's well-being through large income-increasing effects and higher empowerment but has no effect on rural men's well-being. At the household level, we find that, when only women diversify, households have lower per capita income but are less likely to be food-insecure than when only men or both genders diversify. Our findings indicate that policies that promote non-farm diversification strategies in rural Senegal can translate into better livelihood outcomes for rural women and their households.

Keywords: Diversification strategies, Rural Senegal, Women, Well-Being
JEL: E24, I31, J16, O12

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I. Introduction

Senegal has grown rapidly over recent years, with a GDP growth rate ranging from 3.1% to 6.7% during 2000-2018 (World Bank, 2019). As welcome as this recent growth has been, it has not translated into substantial poverty reduction. About one-third (32.6%) of the population lives in poverty.[1] According to the 2011 poverty-monitoring survey, the majority of the poor (57.1%) live in rural areas and are dependent on agriculture for their livelihoods. The agricultural sector remains dominated by women, who account for 60% of the workforce and are responsible for more than half of the country's food production (Agence Nationale de la Statistique et de la Démographie, 2013, 2020; International Fund for Agricultural Development, 2019a, b). Despite their important role as food producers, women have less access to and control over productive resources. Land legislation that guarantees gender-equitable land ownership is barely enforced. In most cases, women are excluded from land ownership or from inheriting land (Ndiaye, 2007; Koopman, 2009; International Fund for Agricultural Development, 2019b).The problem seems to be further exacerbated by the loss of arable land[2] because only 13.8% of landowners are women.

The Government of Senegal has implemented the National Strategy for Gender Equity and Equality as a means of guaranteeing equal access for women and men to productive resources and economic opportunities. Recent years have seen positive changes in women's access to agricultural inputs and land (Revue Annuelle Conjointe, 2018). However, women are still at greater risk of poverty in rural Senegal. They are typically engaged in low productive segments or employed in family based, small-scale farms, while rural men tend to be concentrated in higher-value-added activities in the agricultural value chain (Sarr & Wade, 2017). Women also use fewer inorganic fertilizers

[1] This information is taken from the 2018/2019 survey on household living conditions and, specifically, from the first results of the survey published in July 2020. The poverty rate reported in the communication note is not disaggregated by socio-demographic characteristics such as place of residence and gender, which is not very informative about the extent of poverty. The data are not yet publicly available. However, a more comprehensive report on the poverty profile and methodological issues is being prepared and will be released soon. See (Agence Nationale de la Statistique et de la Démographie, 2020) for more information.

[2] Arable land per capita has decreased by more than 50%, from 0.89 hectares in 1961 to 0.21 hectares in 2016 (World Bank, 2019).

and fewer improved seeds and have smaller land holdings and less education compared to rural men (Direction de l'Analyse de la Prévision et des Statistiques Agricoles, 2018; Food and Agriculture Organization of the United Nations, 2018; International Fund for Agricultural Development, 2019b).

These multiple constraints limit women's productivity in the agricultural sector, generally pose a threat to household food security, and often lead women to supplement household income with non-farm economic activities (Slavchevska, Kaaria & Taivalmaa, 2016).

Non-farm activities are now undertaken by more than 30% of the rural population in the developing world (Davis, Di Giuseppe & Zezza, 2017; Van Den Broeck & Kilic, 2019). Specific to Senegal, only 15% of rural households have no non-farm income (Alobo Loison & Bignebat, 2017). The share of rural households participating in non-farm activities across the main agro-ecological zones of the country ranges between 47% in the Niayes (the lowest) and 75% in the Groundnut Basin (the highest) (Initiative Prospective Agricole et Rurale, 2015).

While the expansion of the non-farm sector can offer good opportunities for food security and poverty reduction (see, e.g., Haggblade, Hazell & Reardon, 2007; Fox & Sohnesen, 2016; Tsiboe, Zereyesus & Osei, 2016; Zereyesus et al., 2017), it is important to ensure that rural women are not excluded from increased job opportunities in this sector. As rural non-farm activities grow, however, most are undertaken by men and young people (Démurger, Fournier & Yang, 2010; Van den Broeck & Kilic, 2019). Still, little is known about the opportunities such activities may provide for rural women. This situation points out the need for further case studies and evidence. We build on this perspective to examine the gender-differentiated impact of non-farm diversification strategies in rural Senegal, using both an individual and a household-level approach. More specifically, we focus on two research questions:

1) Do women who diversify into the non-farm sector earn higher incomes and are more empowered than those relying only on farm work?

2) Do households in which only women diversify into non-farm activities are wealthier and more food secure than households in which only men, or both genders diversify?

In line with these questions, we have used an instrumental variable (IV) approach and a multinomial endogenous treatment model to investigate the extent to which diversification strategies lead to improved outcomes for rural women and their households. At the individual level, we found that diversification improves rural women's well-being through large income-increasing effects and higher empowerment but has no impact on rural men's well-being. At the household level, our findings indicate that, when women alone diversify, households have lower per capita income but are less likely to be food insecure than when only men or both women and men diversify.

Our research contributes to the current literature on rural livelihood diversification. While much attention has been paid to the feminization of agriculture (see e.g., Lastarria-Cornhiel, 2008; Food and Agriculture Organization of the United Nations, 2011b; Slavchevska, Kaaria & Taivalmaa, 2016; Gartaula et al., 2017), remarkably little is known about the expanding role of rural women in the non-farm sector. Previous work in this domain has used sex of the household head as a proxy to account for gender differences in terms of income diversification (see Simtowe, 2010; Manjur et al., 2014; Alobo Loison, 2019; Dzanku, 2019). However, this approach is rather restrictive, for it excludes from the analysis women living in households headed by men and men living in women-headed households (Doss et al., 2018). The data used in this study allowed us to overcome this limitation and capture diversification strategies at the individual level. Additionally, our research advances the understanding of the implications of non-farm activities for women's well-being in Senegal because most existing studies have focused on specific regions rather than on the country as a whole, which may possibly have led to low external validity (see e.g., Maertens & Verhofstadt, 2013; Van Den Broeck & Maertens, 2017).

The rest of the study is structured as follows. Section 2 gives an overview of the literature on women's employment and non-farm diversification strategies. Section 3

presents the analytical framework. Section 4 provides a brief description of the data used and reports some summary statistics. Section 5 highlights the empirical framework. Section 6 presents the estimation results and Section 7 concludes with final remarks and policy implications.

II. Literature Review

Women's employment issues in rural areas have received extensive attention among researchers, policy-makers, and gender experts. It is estimated that rural women represent a quarter of the world's population and about half (49%) of the agriculture workforce in low-income countries. Rural women also play an active role in agricultural production, natural resource management, and adaptation to and mitigation of climate change. They produce over 50% of the world's food and are more likely than men to spend nearly all of their income on their family's well-being, especially on child health, education, and nutrition (Food and Agriculture Organization of the United Nations, 2011a; Duflo, 2012; Maertens & Verhofstadt, 2013; Akter et al., 2017; International Labour Organization, 2018). Achieving gender equality would lower fertility in high-population-growth countries and decrease under-five mortality and stunting (World Bank, 2020). It would also increase agricultural production by 2.5 to 4% in developing countries and reduce the number of undernourished by 12% to 17% worldwide (Food and Agriculture Organization of the United Nations, 2011a). This is particularly important because rural households tend to be less food insecure for women-headed than for men-headed households (Dzanku, 2019). That said, rural women face many challenges. Most of them are engaged in precarious jobs, and their economic participation in rural development is largely undervalued (International Labour Organization, 2018). Household chores and childcare responsibilities make them less likely to engage in income-generating activities (Aryal, Mottaleb & Rahut, 2019), and,

when they do, gender disparities in earnings can reach up to 40% ((International Labour Organization, 2018).

Women's contribution to food and nutrition security is also limited by gender-specific constraints. Compared with men, women do not have equal access to productive resources such as land, information, capital, credit, marketing services, and other inputs (Food and Agriculture Organization of the United Nations, 2011a; World Bank, 2012; Alkire et al., 2013; Doss et al., 2018). This differentiated access to resources generally explains the gender gap in agricultural productivity (Peterman, Behrman & Quisumbing, 2014; Aguilar et al., 2015; Rufai, Salman & Salawu, 2018), and often pushes women to pursue off-farm diversification to better meet their household needs (Slavchevska, Kaaria & Taivalmaa, 2016).

Diversification refers to "the process by which rural families build a diverse portfolio of activities and social-support capacities in order to survive and improve their standard of living" (Ellis, 1998, 4). There are several forms of livelihood-diversification strategies. Certain rural households derive their income exclusively from agricultural production through crop diversification or integration of crops, livestock, and forestry. Some rely on their own on-farm production and farm-wage employment that takes place outside the farm household while others combine both farming and non-farming activities (Barrett, Bezuneh & Aboud, 2001). Non-farm activities are undertaken by more than 30% of the rural population (Haggblade, Hazell & Reardon, 2010; Davis, Di Giuseppe & Zezza, 2017; Van Den Broeck & Kilic, 2019), and constitute an important source of rural employment in many African countries (Yeboah & Jayne, 2018). In practice, rural people diversify either for survival (push factors) or for accumulation purposes (pull factors) (Ellis, 2000; Reardon et al., 2006; Losch, Freguin & White, 2012). Push factors that lead individuals to supplement household income with off-farm income-generating activities are of several kinds, such as climate shocks and market failures for credit, insurance or land[3] (Barrett, Bezuneh & Aboud, 2001; Escobal, 2001;

[3] Non-farm activities are often undertaken by households whose members live in areas of low agro-ecological potential, but when households have access to land and live in favorable agroclimatic conditions, agriculture remains the primary source of livelihood (Davis, Di Giuseppe & Zezza, 2017; Djido &

Haggblade, Hazell & Reardon, 2010; Alobo Loison, 2015). Pull factors, on the other hand, refer to the economic opportunities created by rural development and transformation. Examples include better access to information and markets and improved infrastructure services (Escobal, 2001; Reardon et al., 2006; Losch, Freguin-Gresh & White, 2012).

A vast literature on rural livelihood diversification in Sub-Saharan Africa exists.[4] Most of this literature, however, has overlooked the gender dimension of diversification strategies, though such strategies are less likely to be gender-neutral (Dzanku, 2019) because gender relations influence both choices and the impact of diversification strategies (Ellis, 1998). Investigating rural non-farm employment as a whole, without considering gender differences, is valid only if women and men have equal opportunities to participate in and benefit from the process of rural transformation. But the picture is mixed in the literature. While some studies have found that non-farm jobs opportunities are more limited for women (Simtowe, 2010; Manjur et al., 2014; Zakaria et al., 2015), others report that women are more likely than men to engage in the non-farm sector (Lanjouw & Lanjouw, 2001; Canagarajah, Newman & Bhattamishra, 2001). This argument has also been supported by more recent empirical studies that have found that women increasingly work in the non-farm sector (Haggblade, Hazell & Reardon, 2007; Djurfeldt, Djurfeldt & Lodin, 2013) and tend to be more involved in rural non-farm enterprises compared to men (Rijkers & Costa, 2012; Ackah, 2013; Van Den Broeck & Kilic, 2019). The reason for the conflicting results could be that studies have referred to different rural contexts and different years or a failure to account for the heterogeneity of non-farm activities, which differ largely in terms of productivity and profitability (Dercon & Krishnan, 1996; Rahut & Scharf, 2012). In fact, rural women generally dominate low-return, non-farm activities (Haggblade, Hazell & Reardon, 2007; Manjur et al., 2014; Zakaria et al. (2015). Women's ability to pursue high-return activities is limited by many factors, including lack of productive assets and low levels of

Shiferaw, 2018).

[4] See Alobo Loison (2015) for a detailed review of the nature and evolution of rural livelihood diversification in sub-Saharan Africa.

human capital (Food and Agriculture Organization of the United Nations, 2011; Haggblade, Hazell & Reardon, 2007).

III. Analytical Framework

A rural household's decision to diversify into non-farm activities has been examined through several analytical frameworks (e.g., Barnum & Squire, 1979; Squire, Strauss & Singh, 1986; Bezu, 2010). Following this perspective—and given the limited research literature on the gender-differentiated impact of livelihood-diversification strategies—a framework that enables individual- and household-level analysis of diversification strategies helps guide and interpret an empirical examination of whether diversification strategies lead to improved well-being outcomes for women and their households. Studies have found that women's diversification strategies not only contribute to total household income and increase food security (Floro & Swain, 2013; Zereyesus et al., 2017; Alobo Loison, 2019; Dzanku, 2019), but also improve women's empowerment (Buvinić & Furst-Nichols, 2016; Annan et al., 2019; Maligalig et al., 2019). However, such findings cannot be generalized and need to be assessed on a case-by-case basis.

In an individual-level analysis, farming is considered to be the primary, but not the only activity in which rural women are engaged. They may also diversify into non-farm activities. In the setting of rural Senegal, we would expect most women to participate in low-return, non-farm activities (Haggblade, Hazell & Reardon, 2007; Manjur et al., 2014; Zakaria et al. (2015). Rural women may, however, focus solely on domestic tasks and the family farm because women's employment opportunities outside the family farm are generally limited in many developing countries (Hertz et al., 2009; Food and Agriculture Organization of the United Nations, 2011a). This situation relates to the fundamental but testable hypothesis that, for a rural woman to diversify into non-farm

activities, she would have to dedicate less time to domestic tasks, and returns from non-farm activities would need to be at least as high as those from farm activities.

In a household-level analysis, farming is the main economic activity. However, because of the seasonal nature of farming, households may fail to make a living purely from farming work, which leads them to invest in the non-farm sector (Frelat et al., 2016; Alobo Loison, 2019). Women and men in a household have different preferences. As a result, they are expected to decide together who should work on-farm or non-farm or whether they should jointly take up non-farm work to better meet household needs for basic food and non-food items.

Four possible options can be identified: households in which men alone, women alone, or both diversify into non-farm activities and households in which no one diversifies. In this context, empirical analysis is needed to determine the option that best improve household well-being. Given that women tend to dedicate a higher proportion of their income to family welfare than do men (Duflo, 2012; Food and Agriculture Organization of the United Nations, 2011a; Maertens & Verhofstadt, 2013; Akter et al., 2017), the assumption is that households in which women alone diversify into the non-farm sector are less likely to be poor and food insecure than households in which only men diversify.

Overall, we examine the effect of non-farm diversification strategies on women's income and empowerment, also providing evidence on the circumstances under which diversification strategies can best improve household-level income and food security.

IV. Data and Measurement of Key Variables

4.1 Context and Data

To implement our research, we used data from the second Poverty Monitoring Survey (the Enquête de Suivi de la Pauvreté au Senegal or ESPS II), conducted by the Agence Nationale de la Statistique et de la Démographie (National Bureau of Statistics) between August and December 2011. Sampling was based on the 2002 general population and housing census. The ESPS II is a nationally representative survey based on a two-stage sampling with first-stage stratification. In the first stage, a sample of approximately 1,012 enumeration areas (EAs) was selected throughout the country, including 592 in urban areas and 420 in rural areas. In the second stage, eighteen households were selected with equal probability in each of the rural and urban EAs. The survey provided detailed information on a wide range of socioeconomic and demographic characteristics using two different questionnaires: the individual-level questionnaire designed for all household members and the household-level questionnaire completed by the household head. Because the ESPS II sample is nationally representative, most calculations employed sample weights to generate population level-estimates. (See Agence Nationale de la Statistique et de la Démographie, 2013, for a detailed description of the sampling procedure).

4.2 Defining Treatment and Outcome Variables

Because the first research objective was intended to examine the factors that led rural women to adopt diversification strategies and the ways in which those strategies influenced their well-being, our treatment variable was diversification strategies, which simply refers to participation in farm and non-farm employment. The participation of rural communities in non-farm activities stems naturally from the fact that Senegal has a seasonal and rain-fed agriculture, practiced mainly during the rainy season. The country has a long dry season, which is a lean period for agriculture, and, during this time, rural dwellers are sometimes tempted to find off-farm income sources. Based on this fact, we considered that a rural woman would adopt livelihood-diversification strategies (i.e.,

would become involved in farm and non-farm employment) if, during the previous twelve months, she had primarily been engaged in farming and had a secondary job in the non-farm sector. Rural women who diversified their activities represented the treated group while the comparison group consisted of those who practiced farming alone in a twelve-month period. In this context, if a rural woman reported a secondary activity, this was considered non-farm employment. The assumption is reasonable because the seasonality of agricultural in Senegal makes it unlikely that people whose main activity is agriculture could work as intensively on their farms during the dry season as they did during the rainy season.

To assess the impact of livelihood-diversification strategies on rural women's well-being, we used two outcome variables: cash incomes from both farm and non-farm sources and an indicator of women's empowerment in the agricultural sector (i.e., a multidimensional index that captured rural women's decision-making power in four domains—agriculture, livestock, fishing, and forestry). For each domain, the survey gathered information about the person responsible for the management of the productive resources within the household. Because empowerment implies greater responsibilities, women were considered empowered if they were individually responsible for the management of productive resources in at least one domain. Using the Multiple Correspondence Analysis (MCA), we constructed a Rural Women's Empowerment Index (REID) to check whether women were more empowered when they diversified into non-farm activities.

That said, analyzing livelihood-diversification strategies without accounting for the heterogeneity of non-farm activities may hide significant disparities. This is because many low-paid non-farm jobs may exist, even though average earnings in most rural non-farm activities have been found to be higher than in agriculture (Hertz et al., 2009; Winters et al., 2008). For this reason, we classified livelihood-diversification strategies into two groups depending on earnings relative to farming activities. If a woman was engaged in a non-farm secondary job and had earnings below the average in agriculture, we considered the woman to be diversified into low-return, non-farm

activities. Those who earned above this average were classified as having diversified into high-return, non-farm activities.

To investigate the second research objective—an assessment in a broader perspective of the effects of diversification strategies on household well-being—we defined three treatment groups: i) households in which only women diversified, ii) households in which men diversified and iii) households in which both genders diversified. Households in which no member diversified (i.e., purely agricultural households) represented the comparison group: households in which none of the members participated in non-farm activities over the previous twelve months. The outcome variable was household well-being, captured by two different indicators: household cash incomes per member and household food security status. Household cash income per member was defined as the total labor income generated by farming and non-farming activities relative to the household size. Regarding household food security, a household was defined as food insecure if they reported being sometimes, often, or always unable to meet their food needs over the previous twelve months. To simplify, we rescaled the food security indicator into a dummy variable, taking a value of one if the answer was 'sometimes', 'often' or 'always' and zero otherwise.

The explanatory variables used in this study included demographic and socioeconomic factors that have been previously explored in the literature as potential determinants of diversification strategies (e.g., Démurger, Fournier & Yang, 2010; Djido & Shiferaw, 2018; Van Den Broeck & Kilic, 2019): age, marital status, education, household size, number of Working members of household, household land size, and household exposure to shocks. We also accounted for household chores using the domestic=workload variable, a continuous variable that reflected the time spent on domestic tasks such as cooking, cleaning, washing, caring for family members, and collecting water and firewood. The time-intensive nature of domestic tasks (chores and care work) usually restricts women's ability to participate in off-farm employment (e.g., Qiao et al., 2015; Aryal, Mottaleb & Rahut, 2019). Next, we controlled for the number of adult women within the household to determine the extent to which the presence of

other family members at home affected women's decision to diversify. A brief description of all explanatory variables is given in Appendix Table A1.

The descriptive statistics reported in Table 1 below summarize the characteristics of rural women and men. Two groups are identified: "Diversified" and "Non-Diversified" individuals. The former diversifies their livelihoods off-farm; the latter, who represent a large majority, focus only on farming.

Of individuals with income diversification, only 29.30%[5] of them were women, indicating that non-farm diversification was livelihood strategy predominantly practiced by men. This is in line with studies that have found that men and young people tended to participate more in non-farm activities (Démurger, Fournier & Yang, 2010; Van Den Broeck & Kilic, 2019). Rural women who chose to diversify spent less time on domestic tasks (14.10 hours per week) compared to those who did not diversify (20.74 hours per week). This suggests that performing domestic tasks tended to reduce the likelihood of engaging in diversification strategies. Compared with rural women and men who did not diversify, those who chose to diversify tended to live in smaller households with more working members. Rural dwellers (women and men) who diversified their activities earned higher incomes and were more empowered than their counterparts who did not diversify, suggesting that diversification strategies tended to be associated with a greater improvement in individual well-being.

Table 1 also shows that rural women and men were more likely to diversify when they were located closer to the main road. On average, the nearest main road was distant 1.1083 km (for women) and 1.141 km (for men) without income diversification, and only 0.386 km and 0.849 km away for women and men with income diversification, respectively. In addition, rural women and men who diversified tended to belong to community with a higher level of diversification, indicating that community networks may facilitate the adoption of non-farm diversification strategies.

[5] 699/(699+ 1686).

Table 1: Characteristics of Rural Dwellers

Variables	Rural women Non-Diversified	Diversified	T-test Difference [a]	Rural men Non-Diversified	Diversified	T-test Difference
Time spent on domestic tasks (hours)	20.745	14.102	6.644***	4.230	3.721	0.509
	[0.274]	[1.061]		[0.148]	[0.314]	
Household size	14.158	13.215	0.943***	13.758	12.467	1.291***
	[0.075]	[0.329]		[0.086]	[0.190]	
Household working members	4.924	6.413	-1.489***	4.853	5.697	-0.844***
	[0.036]	[0.212]		[0.041]	[0.116]	
Monthly income (euros)[b]	15.645	83.262	-67.617***	67.581	294.186 [33.282]	-226.604***
	[0.542]	[4.999]		[2.593]		
Empowerment Index	0.016	0.246	-0.230***	-0.050	0.038	-0.087***
	[0.009]	[0.041]		[0.010]	[0.026]	
Distance to all-weather roads (km)	1.083	0.386	0.696***	1.141	0.849	0.292***
	[0.037]	[0.057]		[0.045]	[0.088]	
Ratio of diversification	0.108	0.249	-0.140***	0.108	0.176	-0.068***
	[0.001]	[0.008]		[0.001]	[0.004]	
Number of observations	15027	699		11013	1686	

Notes: [a] The value displayed for t-tests is the differences in the means across the groups, i.e., z-test for dichotomous variables and t-test for continuous variables. [b]In this study, the CFA are fixed to the euro in a ratio of 1 euro = 658 CFA francs. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level. Standard errors are between brackets. Survey weights included. Source: Authors' calculations using ESPS-II data.

In Table 2, we observe that households with women's diversification strategies by women scored better on the two well-being indicators than did households without income diversification (i.e., purely agricultural households). In fact, households in which solely the women adopted diversification strategies had significantly higher incomes and were less likely to be food insecure (Columns 1 and 4). This also held true in households in which solely the men diversified and in households in which both men and women diversified compared with households without income diversification (Columns 2 and 4; Columns 3 and 4). Table 2 shows that, when solely the women diversified, households appeared to have lower per capita income but were less likely to be food insecure than they were in the case in which solely the men diversified or both men and women diversified (Columns 2 and 4; Columns 3 and 4). In households in which both genders diversified, per-capita

income tended to be higher than when solely the men or solely the women diversified.

Table 2: Well-Being Indicators for Households with and Without Income Diversification

Indicators	(1) Households in which only women diversify		(2) Households in which only men diversify		(3) Households in which both men and women diversify		(4) Households in which no member diversifies	
	N	Mean/SE	N	Mean/SE	N	Mean/SE	N	Mean/SE
Food security status (%)	244	10.40 *[0.023]*	1323	17.3 *[0.013]*	719	21.20 *[0.019]*	3202	21.30 *[0.009]*
Per-capita household income (***euros***)	244	27.146 *[2.543]*	1323	53.209 *[4.856]*	719	50.362 *[3.046]*	3202	17.238 *[0.709]*

Note: Standard errors are in brackets. Survey weights included. Source: Authors' calculations using ESPS-II data.

Overall, Table 2 indicates that households that adopt diversification strategies seem to be better off than those that focus only on agriculture. Poorer households, however, appear less likely to diversify than richer households. This is illustrated in Table 3, which shows an over-representation of diversified households in the richest quartiles (i.e., the third and fourth quartiles) and an over-representation of non-diversified households in the poorest quartiles (i.e., the first and second quartiles). As such, diversification out of farming tends to be a matter of accumulation rather than survival, and poorer households or less-endowed-households diversify less, probably due to a lack of necessary productive assets.

The findings at this stage are instructive but not conclusive because factors other than diversification can influence indicators of well-being. We addressed this limitation with the econometric approach that is discussed below.

Table 3: Household Diversification Strategies by Per Capita Income Quartile

	Households in which only women diversify	Households in which only men diversify	Households in which both men and women diversify	Households in which no member diversifies
Per capita income quartile				
1st	4.45	4.91	4.59	38.91
2nd	24.11	18.75	15.02	29.64
3rd	13.10	31.67	32.82	20.49
4th	58.35	44.67	47.57	10.96

Notes: Survey weights included. Source: Authors' calculations using ESPS-II data.

V. Empirical Strategy

Building on the analytical framework provided above, we adopted a two-step approach to investigate the extent to which diversification strategies led to improved well-being outcomes for rural women and their households.

5.1. Estimating the Effects of Diversification Strategies on Individual Well-Being

In order to assess the effects of diversification strategies, we estimated regression model of the following type:

$$Y_i = X_i\,\alpha + T_i\beta + \mu_i \quad (1)$$

where Y_i is the outcome variable of interest (cash incomes, empowerment index) for rural woman i. X_i is a vector of individual and household-level control variables mentioned above. T_i is a binary variable that takes the value of 1 if rural woman i adopts diversification strategies and 0 otherwise, and μ_i is a random error term.

For the cash incomes and empowerment models, Equation 1) is estimated in

linear form. Of particular interest in the two models is the parameter β, which allows us to capture the difference in outcomes between rural women with and without diversification strategies. If positive and statistically significant, it indicates that livelihood-diversification strategies are associated with improved women's well-being.

When estimating Equation 1 using OLS, an endogeneity problem may arise because an individual's decision to diversify into the non-farm sector is not random. Rather, it is linked to a set of observed and unobserved factors, which could lead to biased estimates of β. One way to deal with this potential source of bias is to use an instrumental variable approach (IV). To do so, at least one exogenous instrument is needed that must be correlated with diversification but does not influence the outcome variables. We used two such instruments in this study. The first was the ratio of diversification defined as the proportion of laborers with diversified activities (i.e., combining farming and non-farming work) to total laborers in the community. (Individuals residing in more diversified communities are more likely to learn about livelihood diversification and its possible advantages; arguably, higher community involvement in diversification facilitates an individual's decision to diversify as shown in Table 2.) The second is distance to all-weather road, indicating the distance from the household to the nearest main road.

The data in Table 2 show that individuals living in households located closer to a main road were more likely to diversify, probably because easier access to infrastructure such as transportation results in more non-farm opportunities. This combined information indicates that both instruments are related to the endogenous variable. However, for the instruments to be valid, they must also not influence women's well-being (i.e., women's income and empowerment), except via effects on diversification. Below, we report the results of formal tests of the validity of the variables used as instruments.

Using the IV approach, we estimate the effects of diversification into the non-farm sector with the two-stage least square method. The first stage involves regressing the endogenous variable (diversification) on the two instruments and other exogenous

variables to isolate the problem-free component of the diversification variable that is not correlated with the error term. The second stage uses the problem-free component of the endogenous variable, no longer correlated with the regression model's error term, to estimate the coefficient of interest (β).

5.2. Estimating the Effects of Diversification Strategies on Household Well-Being

In this subsection, we describe the methodology we adopted to assess the effects of diversification strategies on household well-being. A simple way to investigate this issue would be to use OLS by including, in the household well-being model, a variable that captured diversification along with a vector of other independent variables as follows:

$$Y_i = \beta x_i + \theta D_i + \varepsilon_i \quad (2)$$

where ε_i is the error term, and β and θ are the parameters to be estimated.

The outcome variable Y_i is the well-being of the household i. As mentioned, two indicators of well-being are used: per-capita household income and household food-security status.

Diversification strategy, D_i, is the main variable of interest. It is a multinomial variable of four categories with 1 corresponding to households in which only women diversify, 2 households in which only men diversify, 3 households in which both men and women diversify, and 4 households without income diversification which represents the base group for the empirical analysis. x_i includes a set of household composition and characteristics chosen on the basis of previous studies (see Qiao et al., 2015; Djido & Shiferaw, 2018; Van Den Broeck & Kilic, 2019).

We focused our attention on the estimates of the vector of parameters θ. However, for θ to consistently measure the effects of diversification strategies on household well-being, households should be randomly assigned to the four different categories of groups. If not, estimates could be biased because the implication would be that diversification was exogenous.

The main drawback of OLS is that it does not account for the potential endogeneity of diversification. Better-endowed rural households may be more likely to diversify, so that the benefits of diversification would be overestimated if observed and unobserved characteristics were not controlled. To address this problem, we used a multivalue treatment model which allowed multiple treatment possibilities and controlled for selection bias on observed characteristics. We conducted the analysis based on the augmented inverse-probability weighting method, which involves the use of the "teffects aipw" command in Stata.[6] This approach simultaneously models the probability of treatment and the outcome variable to estimate the potential-outcome means and average treatment effects. While the estimators are considered doubly robust because they provide consistent treatment effects when only one of the two models (i.e., the propensity score modeling component or the outcome regression) is properly specified, they fail to control for selection bias on unobserved characteristics.

A more satisfactory assessment can be done using the two-stage multinomial endogenous treatment model developed by Deb and Trivedi (2006a, b). This method has several advantages, including the ability to correct for selection bias on both observed and unobserved characteristics. Moreover, the procedure can be extended to investigate the effects of endogenous multinomial treatment on any non-negative integer outcome even if Deb and Trivedi's approach (2006a) was initially developed for estimating outcome variables with a negative binomial distribution. This allows the outcome variable to be continuous (e.g., per-capita household income) or binary (e.g., household food security status). The model is estimated using maximum simulated

[6] See Cattaneo (2010) and Cattaneo, Drukker, and Holland (2013) for more information about this approach and the multivalued treatment effects models.

likelihood based on Halton Sequences[7].

In the first stage, we considered rural households to be either all farmers or all diversified, allowing us to classify them into four mutually exclusive groups as described above: (i) households in which only women diversified; (ii) households in which only men diversified; (iii) households in which both genders diversified; (iv) households without income diversification.

Let V_{ij}^{*} denotes the indirect utility associated with the j^{th} group, $j = 0, 1, \ldots, J$ for household i

$$V_{ij}^{*} = z_i' \alpha_j + \delta_j l_{ij} + \eta_{ij} \quad (3)$$

where z_i is a vector of household composition and characteristics that affect the decision to adopt diversification strategies and the outcome of interest, α_j is the vector of parameters to be estimated and η_{ij} are the independently and identically distributed error terms. η_{ij} are assumed to be independent of l_{ij}, which represents the latent factor incorporating the unobserved characteristics common to the household's decision to diversify (the treatment variable) and the household well-being (the outcome variable). Let $j = 0$ denote the control or comparison group and $V_{i0}^{*} = 0$. Recall that the control group is the households without income diversification. Moreover, let d_j be the set of observable binary variables representing the choice of various livelihood options, and collected into a vector of $d_j = (d_{i1}, d_{i2}, \ldots, d_{ij})$. Following Deb and Trivedi (2006b), we assume that the probability of a household i to choose one of the four groups (i.e., the probability of treatment), conditional on the latent factors is:

[7] This was implemented in Stata using Deb's mtreatreg command (2009) with 200 simulations.

$$Pr(d_i|z_i, l_i) = \frac{exp(z_i'\alpha_j + \delta_j l_{ij})}{1 + \sum_{k=1}^{J} exp(z_i'\alpha_k + \delta_k l_{ik})} \quad (4)$$

In the second stage of the model, we investigated the impact of diversification strategies on household well-being, formulating the expected outcome equation as follows:

$$E(y_i|d_i x_i l_i) = x_i'\beta + \sum_{j=1}^{J} \gamma_j d_{ij} + \sum_{j=1}^{J} \lambda_j l_{ij} \quad (5)$$

where y_i is the outcome variable (per-capita household income, household food security status) of household i, whereas x_i is a set of exogenous covariates with associated parameters β, and γ represents a vector of treatment effects relative to the comparison group. Given that $E(y_i|d_i x_i l_i)$ is a function of each of the latent factors l_{ij}, the outcome variable is affected by unobserved characteristics that also affect selection into treatment. The non-linear functional form of the multinomial equation allows the joint model to be identified even if the vector of covariates in the outcome and treatment equations are the same (i.e., $x_i = z_i$). Following Deb and Trivedi (2006a), we do include two exclusion restrictions or instruments to provide more robust estimates. Our instrumental variables are the ratio of diversification and the distance to-all-weather road discussed above. These variables are believed to affect the treatment variable (i.e., diversification), but hardly expected to have a direct effect on the outcomes.

VI. Estimation Results

6.1. Results for the Effects of Diversification Strategies on Individuals' Well-Being

Table 4 shows the results from the first-stage estimates. We first report the binary probit estimates of the likelihood to engage in any diversification strategy (Columns 1 and 4), and then use a more disaggregated approach to distinguish between low- and high-return diversification (Columns 2 and 3; Columns 5 and 6). A comparison of the determinants of participation in low- and high-return diversification activities can provide useful evidence on the incentives and constraints faced by rural women and men into their choice toward the different livelihood-diversification strategies.

At the aggregated level, the results indicated a concave relationship between age and diversification decisions for both women and men. In other words, the likelihood of diversifying first increased and then decreased with age, suggesting that young women and men were more likely to diversify than their older peers. Marital status had a significant and positive coefficient, indicating that rural women and men tended to participate more in diversification strategies after marriage.

Education level (measured by the number of adult women or men with at least a primary education) showed mixed results. In fact, the effect of education on diversification decisions was positive and statistically insignificant for rural women, but negative and statistically significant (albeit at 10%) for rural men. At this level of analysis, this indicates that education did not necessarily facilitate the shift from farming to non-farm diversification, a point to which we return below.

Diversification was negatively influenced by household size and positively affected by the number of Working members of household of a household. That is, rural men and women living in smaller households with more working members were more likely to engage in non-farm diversification strategies. The time spent on domestic tasks (i.e., cooking, cleaning, washing, caring for family members, and collecting water and firewood) was positive and not statistically significant for rural men but strongly negative and statistically significant for rural women. As indicated in the analytical framework, this finding supports the hypothesis that performing domestic

tasks limits women's time and capacity to participate in productive activities (e.g., Van Den Broeck & Maertens, 2017; Aryal et al., 2018).

Rural women and men living in households with more adult women were more likely to adopt diversification strategies, though the effect was statistically significant only for rural men. Household land size had a positive effect on women's diversification strategies, albeit marginally, but was not a significant determinant of men's decisions to diversify into non-farm activities. Unlike women, rural men living in households exposed to shocks tended to diversify more into non-farm activities. However, none of the coefficients was statistically significant.

In sum, compared to rural men, the aggregate estimations indicate that young and married rural women who dedicated less time to domestic tasks and lived in smaller households with more working members were more likely to diversify into non-farm activities.

At the disaggregated level, we found that women's decision to diversify into high-return, non-farm activities appeared to be influenced mostly by age, education, and number of working members.[8] Indeed, young and educated women living in households with more working members were more likely to participate in high-return diversification activities. Interestingly, the findings shown in Columns 1-3 indicate that educated women tended to diversify only in high-return, non-farm activities. This helps explain the insignificant effect of education on diversification decisions shown in Column 1 as well as the negative and significant effect in Column 2. This result is in line with Rahut & Scharf (2012) who found that education was a key determinant of access to more remunerative non-farm activities. Somewhat surprisingly, women's participation in high-return diversification strategies did not seem to be constrained by the time spent on domestic tasks, which often limit mobility and involvement in productive activities. Though counterintuitive, the finding made sense once we explored the survey data. In fact, ESPS II data reveal that the majority of rural women carried out virtually all domestic tasks before and after work and during their days off. Regarding rural men, we found that their decisions to diversify into high-return, non-

[8] We relied only on coefficients that were significant at the 1% level.

farm activities was determined mainly by age, marital status, household size, and number of adult women and laborers per household. That is, rural men were more likely to engage in high-return diversification activities if they were young and married and belong to households with fewer people, more adult women, and more working members.

Table 4: Estimation Results-First Stage—Determinants of Diversification Strategies

	(1)	(2)	(3)	(4)	(5)	(6)
		Rural women			Rural men	
	Aggregate diversification	Low income diversification	High income diversification	Aggregate diversification	Low income diversification	High income diversification
Age	0.006***	0.003***	0.002***	0.01***	0.004***	0.01***
Age squared	-0.00006***	-0.00003***	-0.00003***	-0.0001***	-0.00005***	-0.0001***
Married	0.01***	0.01***	0.003	0.05***	0.005	0.05***
Education level [a]	0.0005	-0.002**	0.002***	-0.002*	-0.002*	-0.0006
Household size	-0.002***	-0.001***	-0.0008**	-0.01***	-0.002***	-0.007***
Time spent on domestic tasks	-0.0001**	-0.00007	-0.00006	0.0002	-0.0001	-0.0001
Number of women	0.0002	0.0002	0.00004	0.007***	0.001	0.005***
Working members of household	0.007***	0.005***	0.002***	0.01***	0.005***	0.008***
Total land size	0.0003*	0.00003	0.0003**	0.0005	-0.0003	0.0008**
Shocks	-0.001	-0.007	0.005	0.007	-0.001	0.009
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Instruments						
Ratio of diversification	0.52***	0.36***	0.15***	0.85***	0.31***	0.53***
Distance to all-weather roads	-0.00091***	-0.0004***	-0.0004***	-0.001***	-0.0004	-0.001***
_cons	-0.14***	-0.07***	-0.06***	-0.2***	-0.07***	-0.12***
N	15,726	15,726	15,726	12,699	12,699	12699

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Survey weights included. [a] For rural women and men, education level is proxied by the number of adult women and men with at least a primary education. Source: Authors' calculations using ESPS-II data.

We performed a set of validity tests to assess the appropriateness of the two variables used as instruments. For an instrument to be valid, it must be relevant (i.e., significantly correlated with the variable suspected to be endogenous) and exogenous (i.e., uncorrelated with the error term). To check for the relevance of the instruments, we used under-identification and weak-identification tests. The results highlighted in Appendix Table A2 strongly reject the null hypothesis of under-identification as indicated by the Kleibergen-Paap rk LM statistic. Table A2 reveals that regressions do not also suffer from the weak identification issue as shown by both the statistics of Cragg-Donald and Kleibergen-Paap Wald rk F, which are above the 10% critical value in all models. The second condition of exogeneity of instruments requires testing the overidentifying restrictions.[9] The Hansen J-statistic indicates that the null hypothesis (i.e., the instruments are uncorrelated with the error term and correctly excluded from the estimated equations) cannot be rejected at the conventional level of significance. Hence, we conclude that the two instruments are valid in all equations. We now turn to the results from the second stage estimation of the impact of diversification strategies on rural women's and men's income.

Starting with rural men, we observed that, when we addressed the endogeneity of diversification using the IV approach, diversification became insignificant with a negative sign (Table 5; Columns 4a to 6a). The loss of statistical significance of diversification is noteworthy and highlights a large bias in OLS estimates that disappears once the IV technique is applied. The findings mean there was no difference in income between rural men adopting diversification strategies and those focusing on farming alone. Diversification out of farming was not as remunerative for rural men, probably because they controlled most of the farm-related productive resources, which seemed to promote agricultural intensification rather than diversification into non-farm employment.

For rural women, the OLS results in Table 6 show that diversification has a positive and significant effect on income. At the aggregated level, rural women who

[9] This test is possible because we have two instruments for our endogenous variable.

adopted diversification strategies earned 64.26 euros[10] more than did women who were involved only in farming activities. Diversification into low-return, non-farm activities also increased the average income of rural women by about 10.91 euros. Furthermore, we found that diversification into high-return, non-farm activities had a significantly positive effect on rural women's well-being, raising their average income by 147.10 euros. That said, the estimated coefficients cannot be interpreted as causal effects because part of the impact of diversification can be attributed to some non-observable factors that affect both diversification and income. Using the IV approach described above would correct this bias and provide more reliable results.

At the aggregate level, the IV estimates reveal that diversification increased rural women's income by around 45.43 euros. Rural women who diversified into low-return, non-farm activities also obtained higher income than their peers specialized in agriculture, with an average difference of 65.08 euros. Finally, we also observed a difference in income of around 149.56 euros between rural women who diversified into high-return, non-farm activities and those who relied on farming alone. As expected, high-return diversification activities have larger income-increasing effects compared than do low-return diversification activities or specialization in farming.

The OLS and IV estimates differed significantly, even though the effects of diversification strategies remained positive and significant after controlling for endogeneity. This indicates that the OLS estimates suffered from selection bias on unobserved characteristics. More striking was the direction of the bias. As shown in the last two models (Table 6; Columns 5b and 6b), income effects increased once the endogeneity problem is addressed. The income gain increased from 10.91 euros in Column 2b) to 65.08 euros in Column 5b), and from 147.10 euros in Column 3b) to 149.56 euros in Column 6b) for high-return diversification activities. This implies that rural women with little or no access to infrastructure and markets seem to benefit more from diversification strategies than do rural women with more favorable initial conditions. This is a welcome finding from a gender equity perspective because one might have expected the opposite, i.e., that the effect of diversification would be larger

[10] In this study, CFA francs are fixed to the euro at a ratio of 1 euro = 658 CFA francs.

for better endowed rural women.

Another question of particular interest is whether poorer rural women benefit more from diversification strategies than richer rural women. We empirically examined this issue by estimating the percentile weight regression (PWR) model developed by Araar (2016),[11] based on income distribution across rural individuals. This approach allowed us to investigate the impact heterogeneity of diversification strategies (i.e., the extent to which the effects of diversification varied depending upon income levels using the same control variables as before).

[11] This approach and its application are described in more detail in Araar (2016).

Table 5: Estimation Results Second Stage—Effects of Diversification Strategies on Rural Men's Income

	(1a) (OLS) Aggregate diversification	(2a) (OLS) Low income diversification	(3a) (OLS) High income diversification	(4a) (IV) Aggregate diversification	(5a) (IV) Low income diversification	(6a) (IV) High income diversification
Diversification[a]	**196.71*** **	**-57.01*** **	**309.97*** **	**-44.81**	**-117.20**	**-72.47**
Age	6.79***	10.01***	6.51***	10.42***	10.29***	10.50***
Age squared	-0.06**	-0.10***	-0.06**	-0.10***	-.010***	-0.10***
Married	47.96***	59.20***	43.27***	61.39***	59.51***	62.56***
Education level	5.16***	4.33***	4.81***	4.311***	4.19***	4.39***
Household size	-4.91***	-7.20***	-4.53***	-7.53**	-7.37***	-7.64***
Time spent on domestic tasks	-0.03	-0.11	-0.04	0.12	-0.12	-0.12
Number of women	7.60***	9.24***	7.32***	9.48***	9.36***	9.56***
Working members of household	-1.03	2.67	-0.85	3.04**	3.07**	3.02**
Total land size	1.89**	2.03**	1.72*	2.08*	2.02**	2.12**
Shocks	-10.37	-7.88	-11.76	-7.33	-7.88	-6.99
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	12,699	12,699	12,699	12,699	12,699	12,699

Notes: [a] The CFA are fixed to the euro in a ratio of 1 euro = 658 CFA francs *** Significant at 1%; ** significant at 5%; * significant at 10%. Survey weights included. Source: Authors' calculations using ESPS-II data.

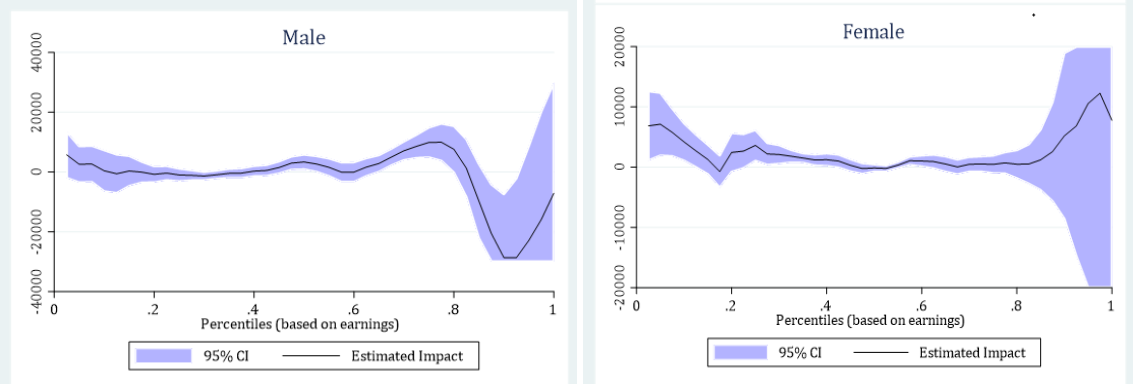
Table 6: Estimation Results-Second Stage—Effects of Diversification Strategies on Rural Women's Income

	(1b) (OLS) Total income diversification	(2b) (OLS) Low income diversification	(3b) (OLS) High income diversification	(4b) (IV) Total income diversification	(5b) (IV) Low income diversification	(6b) (IV) High income diversification
Diversification[a]	**64.26*** **	**10.91*** **	**147.10*** **	**45.43*** **	**65.08*** **	**149.56*** **
Age	2.06***	2.42***	2.04***	2.18***	2.24***	2.03***
Age squared	- 0.02***	- 0.02***	-.022***	-0.02***	- 0.02***	- 0.02***
Married	1.31	2.28*	1.93	1.64	1.52	1.93
Number of educated women	1.23***	1.29***	0.87***	1.24***	1.41***	0.86**
Household size	-0.87***	- 1.02***	-0.90***	-0.92***	-0.93***	-0.90***
Time spent on housework	0.02	0.006	0.020	0.01	0.01	0.02
Number of women	0.42	0.42	0.42	0.42	0.42	0.42
Number of laborers	1.57***	2.06***	1.78***	1.73***	1.71***	1.78***
Total land size	-0.01	0.02	-0.03	0.0007	0.01	- 0.03
Shocks	-1.75	-1.51	-2.59	-1.69	-1.30	-2.60
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	15726	15726	15726	15726	15726	15726

Notes: [a] The CFA are fixed to the euro in a ratio of 1 euro = 658 CFA francs. *** Significant at 1%; ** significant at 5%; * significant at 10%. Survey weights included. Source: Authors' calculations using ESPS-II data.

The PWR model is implemented following a three-step approach. First, we computed the percentiles of the outcome variable (i.e., cash income from farming and non-farming sources). We then generated the Gaussian density around the percentile of interest (i.e., the percentile weights) and, finally, we ran the same IV approach described above by including the percentile weights. The results are illustrated in Figure 1.

Figure 1: Impact heterogeneity of diversification strategies across gender



Sources: Authors' illustrations.

The analysis of heterogeneity shows, as a general pattern, that the diversification effect on income is larger for poor rural men and non-poor rural women. This means, first, that rural men with low incomes benefit more from diversification than do rural men with high incomes and, second, that diversification improves the incomes of well-off rural women (i.e., rural women with high incomes) more than it does for the poor (i.e., rural women with low incomes). The findings in Table 6 suggest that diversification can be an effective tool for raising incomes of rural women. But, as the right panel of Figure 1 shows, women's diversification increases inequality because it increases rather than reduces income differences between rural women in the higher and lower quantiles of the distribution.

In what follows, we focus on the effects of diversification strategies on women's well-being using the rural women's empowerment index. The results obtained with OLS and IV estimators are shown in Table 7. The full regression results are reported in Appendix Table A3.

As Table 7 reveals, the estimates in Columns 4, 5, and 6 are markedly different from those in Columns 1, 2, and 3, suggesting that the OLS results suffered from endogeneity bias. The direction of the bias is also worth considering. The effects of diversification increased once endogeneity was addressed, indicating that diversification seems to be more beneficial for rural women with less favorable conditions, and that the diversification effects would be underestimated if unobserved characteristics were not controlled. The OLS estimates highlight smaller or no effects of diversification strategies on rural women's empowerment (Columns 1-3). In all the models, conversely, diversification had significantly positive effects once the IV approach was employed. Regardless of whether rural women diversified into low- or high-return, non-farm activities, diversified rural women are by far more empowered than women engaged in farming alone. The effects of diversification strategies on rural women's empowerment varied depending on the types of non-farm activities. Rural women were much more empowered when they diversified into high-return, non-farm activities than when they participated in low-return diversification activities (Columns 5-6). These findings suggest that high-return diversification appears to be one of the key opportunities for rural women to empower themselves significantly. As Table 4 highlights, women's ability to engage in high-return diversification strategies was not constrained by household chores or child-rearing obligations, which is good news for policymakers interested in promoting the development of high-return, non-farm rural sectors.

Table 7: Effects of Rural Diversification on Women's Empowerment

	(1) (OLS) Model 1	(2) (OLS) Model 2	(3) (OLS) Model 3	(4) (IV) Model 1	(5) (IV) Model 2	(6) (IV) Model 3
Diversification	0.0833	-0.183*	0.530***	0.933***	1.344**	3.028**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
N	15,726	15,726	15,726	15,726	15,726	15,726

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Model 1 refers to aggregate diversification, Model 2 reflects low-income diversification, and Model 3 refers to high-return diversification. Survey weights included. Source: Authors' calculations using ESPS-II data.

6.2. Results for the Effects of Diversification Strategies on Household Well-Being

This subsection investigates the effect of diversification strategies on household well-being. To do so, we first reported the results of the OLS or logistic regression depending upon the indicator we used to measure the household well-being (i.e., per-capita household income or household food security status). In a second step, we showed the results from the augmented inverse-probability weighting (AIPW) method, and, in the last step, we provided the estimates obtained from the two-stage multinomial endogenous treatment (MET) model. Note that the first stage results are not presented here because the analysis follows the same analogy as that demonstrated in in the previous subsection in Table 4. For convenience, all the estimation results are summarized in Table 8, but more detailed regression results are provided in Appendix Table A4. The purpose here is to examine the conditions under which household well-being is most likely to be improved.

Table 8: Effects of Diversification Strategies on Household Well-Being

	Group 1 Households in which only women diversity			Group 2 Households in which only men diversify			Group 3 Households in which both men and women diversify		
Models	(OLS/LOGIT)[a] (1)	(AIPW) (2)	(MET)[b] (3)	(OLS/LOGIT)[a] (4)	(AIPW) (5)	(MET)[b] (6)	(OLS/LOGIT)[a] (7)	(AIPW) (8)	(MET)[b] (9)
Per-capita household income (euros)[a]	9.18***	9.28***	7.97***	33.26***	33.47***	26.53***	34.50***	38.57***	28.03***
Household food security	-1.074***	-.1083***	-0.224***	-0.330**	-.057***	-0.126***	-0.206	-.030**	-0.102**

Notes: [a] In this study, the CFA are fixed to the euro in a ratio of 1 euro = 658 CFA francs *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Sample size is 5488. Survey weights are included. Source: Authors' calculations using ESPS-II data.

The results in Table 8 provide clear evidence of a significant difference in per-capita household income and household food security status between households with and without income diversification, in favor of those with income diversification. Compared with the OLS and AIPW estimates, the coefficients of diversification obtained from the MET model are adjusted downwards, indicating that the effects of diversification would be overestimated when not controlling for both observed and unobserved characteristics. We consider the MET estimates reported in Columns 3, 6, and 9 to be the preferred regressions because they provide more reliable results.

We found that women's diversification strategies increased per-capita household income by 7.97 euros and reduced the likelihood of being food insecure by roughly 22% compared to non-diversified households. Men's diversification strategies also increased per-capita household income by about 26.53 euros and lowered a household's likelihood of being food insecure by 12.6%. The results further indicate that, when both genders diversified, they increased the income per capita by about 28.03 euros and reduced the mean probability of being food insecure by 10.2%.

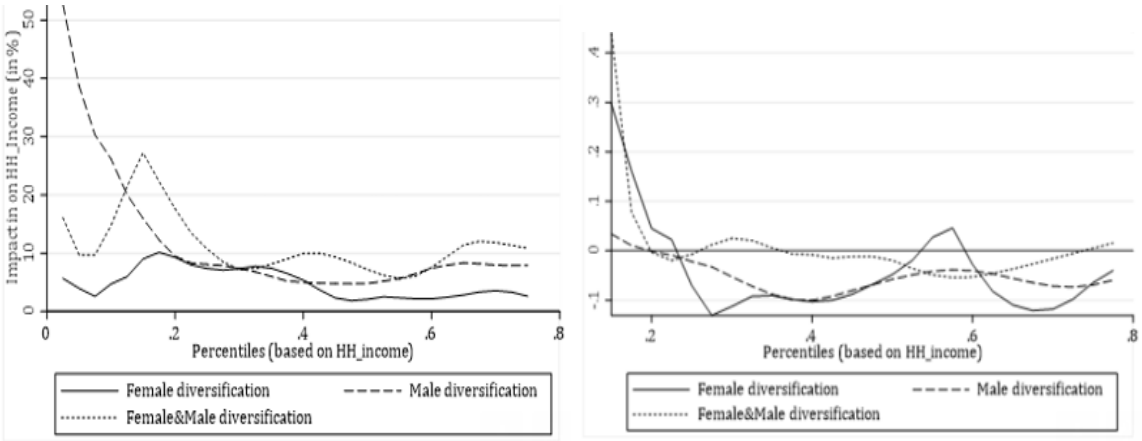
A closer examination of Table 8 reveals some interesting findings. Irrespective of the indicator used, households that adopted diversification strategies did better in improving their well-being than households in which no member diversified (i.e., purely agricultural households). Such a finding provides evidence that combining farm and non-farm activities is required to boost incomes and reduce household vulnerability to food insecurity. This corroborates recent studies (Frelat et al., 2016; Alobo Loison, 2019) in which the authors have emphasized that, while development in the agricultural sector can have a great impact on poverty reduction, relying solely on agriculture is not sufficient to lift rural people out of poverty.

The second important result is that the link between diversification and household food security was more pronounced when only women diversified. That is, households were most likely to be food secure when women alone diversified than when men alone diversified, or when men and women jointly diversified. This is consistent with the general observation that women tend to use a greater share of their income to meet daily household expenses than do men (e.g., Duflo, 2012; Akter et al., 2017). Another interesting result is that diversification was more important in raising per-capita

household income when both genders diversified than when only women or men adopted diversification. This increase in living standards reflects the large income-increasing effects of women's diversification strategies given that diversification has not effect at all on rural men's income (see Table 5).

In the last step of our analysis, we examined the heterogeneity of the impact of diversification strategies at the household level based on the distribution of outcome variables. We use percentile weights regression (PWR) for that purpose (see Araar, 2016). The results are illustrated in Figure 2. The left panel of Figure 2 shows that, for both poor and non-poor households (i.e., households in lower and higher quantiles, respectively), the impact of diversification on per-capita household income is more significant when both genders diversify than when only men or women diversify. The effects of diversification also decrease across the income distribution, implying that poor households benefit more from diversification strategies than do non-poor households and indicating that, when men or women in poor households diversify in the non-farm sector, they increase per-capita household income more than do those in non-poor households.

Figure 2: Impact heterogeneity of diversification strategies across household groups.



Impact of household diversification programs Impact of household diversification programs
Outcome: Household income Outcome: Food Insecurity Status

Figure 2 also shows that the impact of diversification on food security differs significantly across poor and non-poor households (right panel). Poor households

tended to be less food-insecure when men alone diversified while, in non-poor households, diversification was more important in decreasing the likelihood of being food-insecure when women alone diversified. Figure 2 also shows that the impact of diversification on food security diminishes across the distribution. Obviously, food insecurity is not an issue for those who are not initially poor.

Figures 1 and 2 highlight large heterogeneity across poor and non-poor households, and not accounting for this heterogeneity may mask substantial information about the impact of diversification on well-being outcomes.

VII. Conclusions and Policy Implications

Using data from the Senegalese Poverty Monitoring Survey, we have provided novel insights into how involvement in non-farm diversification strategy differs by gender and the implications for well-being. The first focus of our research was to investigate what variables, at the individual and household level, determined women's and men's participation in non-farm diversification strategies. Our findings revealed that rural women, compared to men, were more likely to engage in diversification into the non-farm sector if they were young and married and belonged to smaller households, more young children, and more working members. Distinguishing non-farm activities in terms of returns, we found that women's decision to diversify into high-return, non-farm activities was mostly determined by age and the number of working members in a household, rather than by domestic tasks or number of young children. That is, women's ability to engage in (high return) diversification strategies was not constrained by household chores.

The second point we examined was whether diversified rural women and men were better off than those who relied on farming activity alone. We found mixed results on the importance of diversification strategies across gender. On the one hand, while diversification is an activity dominated by men, we found no difference in income

between rural men who adopted diversification strategies and rural men who engaged solely in farm work. On the other hand, we found that, regardless of whether rural women diversified into low- or high-return, non-farm activities, rural women who combined farming and non-farming earned by far higher incomes and were much more empowered than were counterpart women who engaged solely in farming. Importantly, when we disaggregated non-farm activities into low- and high-return, we found that well-being-increasing effects were much larger for high-return diversification strategies. The fact that low-return diversification strategies significantly improved women's well-being is of considerable policy importance because rural women do not have easy access to high-return non-farm employment.

Finally, we analyzed the conditions under which household well-being was most likely to be improved, finding that households had significantly higher income levels when both genders diversified but were most likely to be food secure when women alone diversified.

To summarize, the results indicate that women's diversification activities increase their income, enhance their empowerment in agricultural domains, and lead to better food security for their households. These findings suggest that policies that support women's diversification strategies by developing new off-farm income sources and upgrading the existing ones could be one of the most efficient pathways to reduce gender inequalities and food insecurity in rural Senegal.

Policy makers can promote a shift toward diversification strategies in ways that leads to meaningful and measurable changes in outcomes for women and their households. The government of Senegal currently supports crop-diversification strategies through the program component of Recovery and Acceleration of the Agricultural Cadence (PRACAS). Our findings suggest that, in addition to this policy, policymakers that hope to improve well-being outcomes for women and their households could strengthen rural development policy by adopting non-farm diversification strategies and that the government could build on its social-safety-net programs to achieve the same end. This is to some extent the purpose of the Yokk Com Com project, which supports the implementation of income-generating activities. As we have reported, however,

women's ability to pursue high-return, non-farm activities mainly depend upon their level of education. This means that providing technical assistance to women can make non-farm activities more accessible and sustainable. This can be done in local languages for better outreach. Improving their skills would create more economic opportunities and more remunerative non-farm jobs for rural women.

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Appendices

Table A1: Definition of Explanatory Variables

Definition of variables	Description
Age	Age in full years
Married	1 if married (monogamous or polygamous)
Number of educated people	Number of adult women and men in household with at least primary education
Household size	Number of persons in the household
Domestic workload	Time spent on domestic tasks such as cooking, cleaning, washing, caring for family members, and collecting water and firewood
Number of women	Number of adult women in the household age 15 to 65 years
Working members of household	Number of workers in the household
Household land size	Size of cultivated area of the household in hectares
Shocks	1 if household experienced a shock. (Shocks can refer to illness, death of a family member, loss of employment, or natural disasters such as floods, droughts, or livestock epidemic
Ratio of diversification	The proportion of laborers with diversified activities (i.e., combining farming and non-farming work) to the total laborers in the community in which the individual resides
Distance to all-weather roads	Distance in kilometers from the household to the nearest highway
Region dummies	A series of binary variables indicating the region in which the individual/household resides

Table A2: Tests of Validity of Instruments

Null hypothesis (H0)	Test statistics	Aggregate diversification	Rural women Low-return diversification	Rural women High-return diversification	Aggregate diversification	Rural men Low-return diversification	Rural men High-return diversification
Instrument Relevance tests							
Model is not identified	Kleibergen-Paap rk LM statistic	194.733***	135.074***	52.829***	226.143***	80.375***	122.073***
(Under-identification)		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Excluded instruments are weakly correlated with the endogenous regressor (Weak identification)	Cragg-Donald Wald F statistic	312.144	223.026	73.705	263.731	86.527	147.597
	Kleibergen-Paap rk Wald F statistic	105.799	70.791	27.001	119.967	41.339	62.327
Instrument Exogeneity (overidentification) test	Sargan-Hansen	0.431	0.605	0.137	1.201	1.163	1.223
Excluded instruments are uncorrelated with the error term	J-statistic	(0.5115)	(0.4367)	(0.7109)	(0.2732)	(0.2809)	(0.2688)
and correctly excluded from the estimated equation							

Notes: P-values of LM and Sargan J statistics are in parenthesis. *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Stock-Yogo critical values for partial F statistics are 6.46 for 10% and 4.36 for 15% maximal relative bias. Stock-Yogo critical values for weak identification tests (used for Cragg-Donald Wald and are Kleibergen-Paap rk Wald F statistics) are 5.44 for 10% and 3.81 for 15% maximal relative bias.
Sources: Authors' calculations using ESPS II data.

Table A3: Effects of Diversification Rural on Women's Empowerment

	(1) (OLS) Aggregate diversification	(2) (OLS) Low income diversification	(3) (OLS) High income diversification	(4) (IV) 1st STAGE Aggregate diversification	(5) (IV) 2nd STAGE Aggregate diversification	(6) (IV) 1st STAGE Low income diversification	(7) (IV) 2nd STAGE Low income diversification	(8) (IV) 1st STAGE High income diversification	(9) (IV) 2nd STAGE High income diversification
Diversification	**0.0833**	**-0.183***	**0.530*****		**0.933*****		**1.344****		**3.028****
Age	0.0108	0.0118	0.00975	0.00596***	0.00585	0.00311***	0.00724	0.00285***	0.00275
Age squared	-0.0000729	-0.0000833	-0.0000624	-0.0000609***	-0.0000227	-0.0000314**	-0.0000375	-0.0000296***	0.0000103
Married	-0.105**	-0.102**	-0.105**	0.0144**	-0.117**	0.0129**	-0.121**	0.00149	-0.108**
Literate	0.108**	0.106**	0.107**						
Household size	-0.0503***	-0.0511***	-0.0498***	-0.00403***	-0.0467***	-0.00249***	-0.0471***	-0.00154**	-0.0458***
Carry out homework	-0.0301	-0.0325	-0.0287	-0.00343	-0.0195	-0.00180	-0.0205	-0.00163	-0.0175
Number of women	0.0643***	0.0643***	0.0640***	0.000505	0.0640***	-0.000202	0.0648***	0.000707	0.0624***
Number of preschoolers	-0.0341**	-0.0336**	-0.0345**	0.00211	-0.0362**	0.00103	-0.0356**	0.00109	-0.0375**
Number of children	-0.000125	0.000570	-0.000508	0.00394**	-0.00308	0.00254*	-0.00281	0.00140	-0.00368
Number of laborers	0.0568***	0.0588***	0.0563***	0.00811***	0.0490***	0.00601***	0.0485***	0.00210***	0.0502***
Total land size	0.00375**	0.00383**	0.00361**	0.000399	0.00328*	0.0000877	0.00353**	0.000312*	0.00271*
Shocks	0.195***	0.195***	0.192***	-0.00188	0.192***	-0.00662	0.199***	0.00474	0.176***
Instruments									

Ratio of diversification				0.529***		0.368***		0.162***				
Distance to all-weather roads				-0.000920***		-0.000455**		-0.000465***				
_cons	-0.356*	-0.376**	-0.338*		-0.262		-0.286		-0.208			
N	15726	15726	15726		15726		15726		15726			

Table A4: Effects of Diversification on Household Well-Being (i.e., Household Income)

	(1) (MCO)	(2) (MET) 1st Stage	(3) (MET) 1st Stage	(4) (MET) 1st Stage	(5) (MET) 2nd Stage
Gender of household head (women=1)	-5834.4***	1.154***	-1.417***	-0.316	-6551.6***
Age of household head	200.7	-0.00147	-0.0415*	-0.0109	178.1
Age squared of household head	-2.12	0.0000743	0.000231	-0.0000109	-2.026
Education of household head (ref. no education)					
Primary	-2358.8	0.247	-0.185	0.0660	-2457.4
Secondary	1270.2	0.0511	0.194	0.599*	1515.4
Number of laborers	661.5	0.297***	0.191***	0.282***	846.5*
Household size	-1108.6***	-0.146**	-0.0206	-0.0340	-1123.4***
Number of babies	-157.08	-0.105	0.0929*	0.0460	-102.4
Number of children	-589.15	0.0667	0.0135	-0.0178	-603.7
Number of women	365.5	0.0953	-0.0203	0.0185	356.9
Total land size	388.9**	-0.0155	-0.00291	0.0109*	390.5*
Shocks	710.4	0.274	0.0378	-0.115	730.1
Treatment					
Diversification (*Ref=Households without income diversification)*					
Households with women's income diversification	6043.9***				5247.4***
Households with men's income diversification	21885.8***				17459.6***
Households with both women's and men's income diversification	22702.1***				18449.5***

Instruments					
Ratio of diversification		5.036***	6.168***	7.807***	
Distance to all-weather roads		-0.0500	-0.0208**	-0.0123	
_cons	19981.6	-3.389*	2.355*	0.264	
Observations	5488	5488	5488	5488	5488
Lnsigma					10.646***
lambda 1 (Households with women's income diversification)					904.20***
lambda 2 (Households with men's income diversification)					5198.42*
lambda 3 (Households with both women's and men's income diversification)					4903.17**

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Sources: Authors' calculations using ESPS II data.

Table A5: Effects of Diversification on Household Well-Being (i.e., Household Food Security)

	(1)	(2)	(3)	(4)	(5)
	(LOGIT)	(MET) 1st Stage)	(MET) 1st Stage)	(MET) 1st Stage)	(MET) 2nd t Stage)
Gender of household head (women=1)	0.0600	1.167***	-1.422***	-0.320	0.00165
Age of household head	-0.0219	0.000449	-0.0411*	-0.00964	-0.00337
Age of household head squared	0.000254	0.0000593	0.000226	-0.0000223	0.0000386
Education of household head (ref: no education)					
Primary	-0.532**	0.251	-0.183	0.0652	-0.0609**
Secondary	-0.370	0.0404	0.197	0.595**	-0.0390
Number of laborers	0.0678***	0.298***	0.190***	0.281***	0.0127***
Household size	-0.0515*	-0.146**	-0.0219	-0.0339	-0.00789*
Number of preschoolers	-0.0145	-0.104	0.0962	0.0445	-0.00431
Number of children	0.0666	0.0684	0.0137	-0.0178	0.00763
Number of women	0.0175*	0.0933	-0.0194	0.0181	0.00349
Total land size	-0.0205**	-0.0163	-0.00210	0.0107*	-0.00172***
Shocks	2.110***	0.288	0.0323	-0.111	0.450***
Treatment					
Diversification (*Ref=Households without income diversification)*					
Households with women's income diversification	-1.074***				-0.224***
Households with men's income diversification	-0.330**				-0.126***
Households with both women's and men's income diversification	-0.206				-0.102**
Instruments					

Ratio of diversification		5.162***	6.142***	7.800***	
Distance to all-weather roads		-0.0507	-0.0205***	-0.0122	
_cons	-1.017*	-3.460*	2.352*	0.235	
Observations	5488	5488	5488	5488	5488
lnsigma					-1.110***
lambda 1 (Households with women's income diversification)					0.111***
lambda 2 (Households with men's income diversification)					0.105***
lambda 3 (Households with both women's and men's income diversification)					0.0908**

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%. Sources: Authors' calculations using ESPS II data.