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

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Thierno Malick DIALLO
Amoudath Mazu
Marième Fatou SEYE
Fatou MBOUP
Abdoulaye DIEYE
Ibrahima NDIAYE

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Abstract

The rural non-farm sector is expanding in Senegal and in many other developing countries. For rural women, this situation poses challenges and opportunities that are not yet fully understood. The present study examines how involvement in non-farm diversification strategy differs by gender and its implications for individual and household well-being in rural Senegal. We find that non-farm diversification is a male-dominated livelihood strategy. However, rural women make the most out of it, regardless of whether they diversify into low or high return non-farm activities. Diversification improves rural women's well-being through large income-increasing effects and higher empowerment level, but has no effect on rural men's well-being. At 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

Authors

Thierno Malick DIALLO:

Lecturer, University of Gaston Berger, Saint-Louis, Senegal. Email:
malikidiallo@gmail.com

Amoudath MAZU:

Lecturer, University of Gaston Berger, Saint-Louis, Senegal.
Email:
zamoudath@africanschoolofeconomics.com

Marième Fatou SEYE:

Master Student, University of Gaston Berger, Saint-Louis, Senegal. E-mail:
mefesha@yahoo.fr

Fatou MBOUP:

PhD Student, University of Gaston Berger, Saint-Louis, Senegal. E-mail:
ndoumbelabrave@gmail.com

Abdoulaye DIEYE:

Economist, CEPOD, Dakar, Senegal. E-mail:
dieyeabdoulaye@hotmail.com

Ibrahima NDIAYE:

Economist, UCSPE, Dakar, Senegal. E-mail:
iboundiaye30ucspe@gmail.com

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I. Introduction

Senegal has grown rapidly over the last years, with a GDP growth rate ranging from 3.1 percent to 6.7 percent in the period between 2000 and 2018 (World Bank, 2019a). As welcome as this recent growth has been, it has not been translated into substantial poverty reduction. About one-third (32.6 percent) of the population lives in poverty¹. According to the 2011 poverty monitoring survey, the majority of the poor (57.1 percent) live in rural areas and are dependent on agriculture for their livelihoods. The agriculture sector accounts for less than 20 percent of GDP and remains dominated by women who are responsible for more than 70 percent of the country's food production (ANSD, 2013; IFAD, 2019a; Seck, 2019; ANSD, 2020).

Despite their important contribution to agriculture, women have limited access and control over key resources. Land legislation that guarantees a gender-equitable land tenure is barely admitted and enforced. In most cases, women are excluded from inheriting land and land ownership (Ndiaye, 2007; Koopman, 2009; IFAD, 2019b). The problem seems to be further exacerbated by the loss of arable land², as only 13.8 percent of women now own land, against 86.2 percent of men.

The Government of Senegal has implemented the National Strategy for Gender Equity and Equality (SNEEG) as a key strategy to guarantee equal access of women and men to productive resources and economic opportunities. Recent years have seen positive changes in women's access to agricultural inputs and land (RAC, 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-scaled farms, while rural men tend to be concentrated in higher value-added activities in the agricultural value chain (Sarr and Wade, 2017). Women also use less inorganic fertilizers, less improved seeds, and have smaller land holdings and less education as compared to rural men (DAPSA, 2018; FAO, 2018; IFAD, 2019b). These multiple constraints limit women's productivity in the agriculture sector, generally pose a threat to household food security, and often lead some women to supplement household income with some non-farm economic activities (Slavchevska et al., 2016). Non-farm activities are undertaken by more than 30 percent of the rural population in the developing world (Davis et al., 2017; Van den Broeck and Kilic, 2019). Specific to Senegal, only 15 percent of rural households do not have any non-farm incomes (Alobo Loison and Bignebat, 2017). The share of rural households participating in non-farm activities across the main agro-ecological zones of the country ranges between 47 percent in the Niayes (the lowest) and 75 percent in the Groundnut Basin (the highest) (IPAR, 2015). This expansion of the non-farm sector can have important implications for food security and poverty alleviation (see e.g., Haggblade et al., 2007; Fox and Sohnesen, 2016; Tsioboe et al., 2016; Zereyesus et al. 2017). However, this also poses challenges and opportunities for rural

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 elaborated and will be released soon. See ANSD (2020) for more information.

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

women that are not yet fully understood as most of the non-farm activities are undertaken by men and young people (Démurger et al., 2010; Van den Broeck and Kilic, 2019). This situation points out the need for more case studies and evidence. The present research paper builds on this perspective and aims to examine the gender-differentiated impact of non-farm diversification strategies in rural Senegal. More specifically, we focus on two research questions:

- 1) Do women who diversify into the non-farm sector are better off in terms of income and empowerment than those relying only on farm work?
- 2) Do households where only women diversify into non-farm activities are better off in terms of income per capita and food security than households where only men or both genders diversify?

Drawing on the existing literature (e.g., Buvinić and Furst-Nichols, 2014; Annan et al., 2019; Maligalig et al., 2019), we expect that diversification strategies improve rural women's well-being by increasing their income and empowerment. We also expect that the impact of diversification strategies on household well-being differs by gender as women and men are known to have different income allocations. In fact, earlier studies have shown that women tend to use a greater share of their income to meet the basic needs of children and other family members than do men (Duflo, 2012; FAO, 2011a; Maertens & Verhofstadt, 2013; Akter et al., 2017). In addition, given the rainfed nature of agriculture in Senegal, we consider that rural households may fail to make a living from relying purely on farming work as pointed out by Frelat et al. (2016) and Aloba Loison (2019). Thus, we hypothesize that rural households when women diversify into the non-farm sector are less likely to be poor and food insecure (e.g., Floro and Swain, 2013; Zereyesus et al., 2017; Dzanku, 2019).

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; FAO, 2011b; Slavchevska et al., 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; Aloba Loison, 2019; Dzanku, 2019). However, this approach is rather restrictive because it excludes from the analysis women living in male-headed households and men living in female-headed households (Doss et al., 2018). The data used in this study allows us to overcome this limitation and capture diversification strategies at individual level. Additionally, our research advances the understanding of the implications of non-farm activities for women's well-being in Senegal as most of the existing studies were focused on specific regions rather than the country as a whole, which possibly leads to low external validity (see e.g., Maertens and Verhofstadt, 2013; Van den Broeck and Maertens, 2017).

The rest of the study is structured as follows: Section 2 gives an overview of the literature on women's employment issue and income diversification. Section 3 presents the data and reports some summary statistics. Section 4 and 5 highlight the theoretical and empirical framework, respectively. 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 percent) of the agriculture workforce in low income countries. Rural women also play an active role in agricultural production, natural resource management as well as in climate change adaptation and mitigation. They produce over 50 percent 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 (FAO, 2011a; Duflo, 2012; Maertens and Verhofstadt, 2013; Akter et al., 2017). 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 percent in developing countries, and reduce the number of undernourished by 12 to 17 percent people worldwide (FAO, 2011a). This is particularly true, as rural households tend to be less food insecure for female- than for male-headed households (Dzanku, 2019). That said, rural women face many challenges in the developing world. Most of them are engaged in precarious jobs and their economic participation in rural development is largely undervalued (ILO, 2018). They are less likely to engage in income-generating activities due to household chores and childcare responsibilities (Aryal et al., 2019), and, when they do, the gender earnings gaps can reach up to 40 percent (ILO, 2018). Women's contribution to food and nutrition security is also limited due to some 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 (FAO, 2011a; World Bank, 2012; Alkire et al., 2013; Doss et al., 2018). These differentiated access to resources generally explain the gender gap in agricultural productivity (Peterman et al., 2010; Aguilar et al., 2015; Rufai et al., 2018), and often push women to diversify outside the farm to better meet their household needs (Slavchevska et al., 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 p.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 (Barret et al., 2001). Non-farm activities are undertaken by more than 30 percent of the rural population (Haggblade et al., 2010; Davis et al., 2017; Van den Broeck and Kilic, 2019), and constitute an important source of rural employment in many African countries (Yeboah and Jayne, 2018). In practice, rural people diversify either for survival grounds (push factors), or for accumulation purposes (pull factors) (Ellis, 2000; Reardon et al., 2006; Losch et al., 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 land³ (Barret et al., 2001;

³ Non-farm activities are often undertaken by households living in areas of low agro-ecological potential, but when

Escobal, 2001; Haggblade et al. 2010; Aloba Loison, 2015). Pull factors, on the other hand, refer to the economic opportunities created by the process of rural development and transformation. Examples include a better access to information, markets, and improved infrastructure services (Escobal, 2001; Reardon et al., 2006; Winters et al., 2009; Losch et al., 2012).

There is a vast literature on rural livelihood diversification in Sub-Saharan Africa⁴. However, most of the literature has overlooked the gender dimension of diversification strategies. Yet, results are less likely to be gender-neutral (Dzanku, 2019), as gender relations influence both the choices and 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. The literature points to significant gender disparities in participation in non-farm activities, albeit with mixed results. While some studies find 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 2001; Canagarajah et al., 2001). This latter argument has also been supported by more recent empirical studies that find that women increasingly work in the non-farm sector (Haggblade et al., 2007; Andersson Djurfeldt et al., 2013), and tend to be more involved in rural non-farm enterprises compared to men (Rijkers and Costa, 2012; Ackah, 2013; Van den Broeck and Kilic, 2019). The reason for the conflicting results could be that the studies refer to different rural contexts and different years. This could also be due to the failure to account for the heterogeneity of the non-farm activities, which differ largely in terms of productivity and profitability (Dercon and Krishnan, 1996; Rahut and Scharf, 2012). In fact, rural women generally dominate the low-return non-farm activities (Haggblade et al., 2007; Manjur et al., 2014; Zakaria et al. 2015), even if the gender gap in non-farm employment tends to decrease over time (Van den Broeck and Kilic, 2019). Women's ability to pursue high-return activities is limited by many factors including lack of productive assets and low levels of human capital (FAO, 2011; Haggblade et al., 2007). Despite these gender differences in livelihood diversification strategies, it has been documented that female participation in off-farm activities leads to positive outcomes. Research showed that women's off-farm income not only contributes to total household income and increases food security (Floro and Swain, 2013; Zereyesus et al., 2017; Aloba Loison, 2019; Dzanku, 2019), but also improves women's empowerment (Buvinić and Furst-Nichols, 2014; Annan et al., 2019; Maligalig et al., 2019). Our research paper contributes to this existing literature and uses a household and individual-level approach to study the impact of female diversification strategies on well-being outcomes.

III. Theoretical Framework

We present a theoretical model that examines how, in a rural area setting consistent with that of Senegal, women may decide to move from farm to non-farm activities or to involve in both types of

households have access to land and live in favourable agroclimatic conditions, agriculture remains their primary source of livelihood (Davis et al., 2017; Djido and Shiferaw, 2018).

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

activities. To this end, we formalize rural women's choice of activity based on the model of Barnum and Squire (1979), later adapted by Squire et al. (1986) and Bezu (2010).

Without loss of generalities, the revenue from self-farming activities of a representative rural individual is expressed as follows:

$$R_{i,fa} = f_{i,fa}(A, K_{fa}, L_{fa,q}; p) \quad (1)$$

Where A is the average arable land use per person, K_{fa} is the stock of capital devoted to farm activity, $L_{fa,q}$ is the labor input for farm with quality q , and p is the vector of prices of the different inputs and outcomes.

In our model, farming is the primary, but not the only activity in which rural women are engaged. They may also decide to participate either in non-farm wage employment (we) and/or in non-farm self-employment (se). When they involve in wage employment, the main factor taken into account is the quality of the total labor. In line with the first equation, the revenues generated from non-farm activities ($R_{i,nfa}$) can be written as:

$$R_{i,nfa} = f_{i,we}(L_{we,q}; \omega_{we,q}) + f_{i,se}(L_{se,q}, K_{se}; \tau_{se,q}) \quad (2)$$

Where $\omega_{we,q}$ denotes the wage of labor with quality q and $\tau_{se,q}$ is the expected return of the self-employment with quality labor q .

We assume that both farming and non-farming activities have a revenue function characterized by diminishing marginal returns to capital. This suggests that rural individuals need to choose the appropriate activity depending on their physical and capital endowments, which in turn depend on the quality of the labor. Due to certain cultural norms in many developing countries, people may decide to stay at home or not to engage in off-farm employment that requires long working hours. The choice will depend on their family's needs and the satisfaction they feel in fulfilling their social and family commitments. In this context, we consider that an individual has three possible uses for his/her time, expressed as follows:

$$TT = \sum_a T_{La} + \sum_b T_{Hb} + T_{Le} \quad (3)$$

where

- T_{La} is the time spent on productive activities $a \in \{fa, we, se\}$;
- T_{Hb} is the time spent on domestic tasks $b \in \{child\ care, housing\ services, etc.\}$;
- T_{Le} is the time spent on leisure.

Given the revenues derived from farm and non-farm activities, the leisure time and the demographic and socio-economic characteristics, we consider that each rural individual maximizes a well-being

function expressed as: $Max f_i(R_{i,fa}, R_{i,nfa}; H(DN); L_e; X)$

where :

- $f(.)$ is quasi-concave and continuously differentiable;
- $H(.)$ denotes the set of domestic tasks, including child and elderly care services. These are proxied by the presence of babies, the presence of elderly people, including the number of female adults which is used to capture the influence of the presence of other family members staying at home on individual's decision to participate in the labor market;
- L_e is the leisure;
- X is a vector of demographic and socio-economic characteristics that determine rural individual's choices in terms of activities and leisure;

The well-being function is maximized subject to the following constraints:

$$\begin{cases} K_{fa} + K_{se} \leq \bar{K}_i \\ L_{fa,q} + L_{we,q} + L_{se,q} \leq \bar{L}_i \\ TT = \sum_a T_{La} + \sum_b T_{Hb} + T_{Le} \\ L_{fa,q}, L_{we,q}, L_{se,q}, K_{fa}, K_{se} \geq 0 \end{cases}$$

The first constraint represents the available capital for each rural individual. The second constraint is the labor constraint whereas. The third constraint represents the time constraint while the fourth one refers to the non-negativity constraint.

Given the well-being maximization program, an individual participation in the labor force (and potentially in non-farm activities) is primarily conditional on their availability to work and their size of capital endowment. The following proposition summarizes this relationship:

Proposition 1. A labor force participant will diversify into rural non-farm employment if: (i) he/she dedicates less time to domestic tasks, (ii) the minimum capital requirement for investment in non-farm activities is attained, and (iii) the marginal returns from non-farm activities are at least as high as those in farm activities.

Following Huffman and Lange (1989), we now extend the above model to the household level, and this, by considering a farm household that consists of only two members: a husband and a wife. The husband and wife have different preferences but they cooperate in order to improve the well-being of each other. The utility function of each person varies according to his or her consumption of private goods: $U^h(c^h)$ for the husband and $U^w(c^w)$ for the wife. In this model, the threat point, $(T^h(Z), T^w(Z))$, may be either the end of the marriage (i.e. divorce) or a non-cooperative equilibrium within marriage. The time allocation categories include farming, domestic tasks, and leisure time. However, because of the seasonal nature of farming, farm households tend to invest more in the non-farm sector. Thus, we consider that the wife and the husband may decide to participate in non-farm activities (i.e. farm wage employment (we) and/or in non-farm self-employment (se)) to better meet the household needs in terms of basic food and non-food items. In this context, four distinct frameworks can be identified: i) the case where only the wife participates in non-farm activities, ii) the case where only the husband participates in non-farm activities, iii) the case where both the husband and wife

participate in non-farm activities, iv) the case where no one participates in non-farm activities. The unitary model, compared to bargaining model, is more appropriate for illustrating the trade-off between time spent in different type of activities (i.e., farming vs non-farming activities), because in the unitary model the household's preferences are represented by a common utility function. This allows us to specify the total revenues generated from farming activities of the farm household (R_H) as:

$$R_{H,fa} = f_{H,fa}(A, K_{fa}, L_{fa,q,f}, L_{fa,q,m}; p) \quad (4)$$

Where A is the household land area, K_{fa} denotes the allocated stock of capital for farming activity, $L_{fa,q,f}, L_{fa,q,m}$ represent the allocated labor in farm (fa) respectively for the wife and the husband and male (f, m) with labor qualities (q), and p denotes the vector of prices.

We consider that the allocated labor with quality (q) is the main factor that can account for involvement in wage employment. Based on equation (4), the total household revenues derived from non-farm activities ($R_{H,nfa}$) can be expressed as:

$$R_{H,nfa} = f_{H,we}(L_{we,q,f}, L_{we,q,m}; \omega_{we,q}) + f_{H,se}(L_{se,q,f}, K_{se,f}, L_{se,q,m}, K_{se,m}; \tau_{se,q}) \quad (5)$$

Where $\omega_{we,q}$ denotes the wage labor associated with the labor quality q gained by the wife (f) and husband (m), and $\tau_{se,q}$ is the expected return of the self-employment with labor quality q earned by women and men living in the same household.

Where $\omega_{we,q}$ denotes the wage labor associated with the labor quality q gained by women and men within a household, and $\tau_{se,q}$ is the expected return of the self-employment with labor quality q earned by women and men living in the same household.

Besides, we suppose that both women and men within a household have three possible uses for their time, written as follows:

$$TT = \sum_a \sum_g T_{L_{a,g}} + \sum_b \sum_g T_{H_{b,g}} + \sum_g T_{L_{e,g}} \quad (6)$$

where

- $T_{L_{a,g}}$ is the time spent on productive activities $a \in \{f, we, se\}$, with $g \in \{\text{male, female}\}$
- $T_{H_{b,g}}$ is the time spent on domestic tasks $b \in \{\text{child care, housing services, etc.}\}$, with $g \in \{\text{male, female}\}$
- $T_{L_{e,g}}$ is the time spent on leisure, with $g \in \{\text{male, female}\}$

Given the cash revenues generated from farm and non-farm activities, each rural household

maximizes a well-being function captured by the total household revenue, expressed as:

$$\text{Max } f(R_{H,fa}, R_{H,nfa}; H(DN), L_e, X)$$

The household well-being function is maximized subject to the following constraints:

$$\left\{ \begin{array}{l} K_{fa,f} + K_{fa,m} + K_{se,f} + K_{se,m} \leq \overline{K_H} \\ L_{fa,q,f} + L_{fa,q,m} + L_{we,q,f} + L_{we,q,m} + L_{se,q,f} + L_{se,q,m} \leq \overline{L_{q,H}} \\ TT = \sum_a \sum_g T_{La,g} + \sum_b \sum_g T_{Hb,g} + \sum_g T_{Le,g} \\ L_{fa,q,f}, L_{fa,q,m}, L_{we,q,f}, L_{we,q,m}, L_{se,q,f}, L_{se,q,m}, K_{fa,f}, K_{fa,m}, K_{se,f}, K_{se,m} \geq 0 \end{array} \right.$$

The first constraint represents the available capital for each rural household. The second constraint is the labor constraint; the third one is the time constraint⁵ and the fourth one represents the non-negativity constraint. Given the well-being maximization program, a rural household decision to diversify into nonfarm activities depends on the availability and quality of the labor, as well as, the level of capital endowments of the household.

IV. Data and Measurement of Key Variables

4.1 Context and Data

To implement our research, we use data from the second Poverty Monitoring Survey, i.e., *Enquête de Suivi de la Pauvreté au Senegal (ESPS II)*, conducted by the National Bureau of Statistics (ANSD) in August-December 2011. The sampling frame for the data was drawn from 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 1012 enumeration areas (EAs) was selected throughout the country, including 592 in urban areas and 420 in rural areas. In the second stage, 18 households were selected with equal probability in each of the rural and urban EAs. The survey provided detailed information on a wide range of socio-economic 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. See ANSD (2013) for a detailed description of the sampling procedure.

4.2 Defining Treatment and Outcome Variables

As the first research objectives aim to examine the factors leading rural women to adopt diversification strategies, and how these strategies influence their well-being, the treatment variable is diversification strategies, which simply refer 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 rainfed agriculture, practiced mainly during the rainy season. The country has a long

⁵ It is a well-known fact that women may work more and longer hours than men due to household care activities. However, while women available hours per day is often shared between paid work and unpaid, the time constraint is such that women cannot work 48 hours per day.

dry season, which is a lean period for agriculture, and during which rural dwellers are sometimes tempted to find off-farm income sources. Based on this fact, we consider that a rural woman adopts livelihood diversification strategies (i.e. get involved in farm and non-farm employment) if, during the past 12 months, she was primarily engaged in farming and had a secondary job in the non-farm sector. Rural women who diversify their activities represent the treated group while the comparison group consists of those who practice only farming in a 12-month period. In this context, if a rural woman reports having a secondary activity, then this is considered a non-farm employment. It is a reasonable assumption because, due to seasonality of agricultural production in Senegal, it is unlikely that people whose main activity is in agriculture could work intensively on their farms during the dry season as much as they used to in the rainy season. Under these circumstances, the most common type of second activity is working in the non-farm sector.

To assess the impact of livelihood diversification strategies on rural women's well-being, we use two outcome variables. The first outcome variable is the cash incomes derived from both farm and nonfarm sources. The second outcome variable is an indicator of women's empowerment in the agricultural sector, i.e., a multidimensional index that captures rural women's access to decision-making power in four domains, namely, agriculture, livestock, fishing, and forestry. For each domain, the survey asks about the person mainly responsible for the management of the household's production activities. Using this information, we apply the Multiple Correspondence Analysis (MCA) to construct a Rural Women's Empowerment Index (RWEI).

That said, analyzing livelihood diversification strategies without accounting for the heterogeneity of the non-farm activities may hide some significant disparities. This is because there may have many low-paid non-farm jobs, even though average earnings in most of rural non-farm activities are found to be higher than in agriculture (Hertz et al.,2009; Winters et al.,2008). For this reason, we classify livelihood diversification strategies into two groups depending on earnings relative to farming activities. If a woman is engaged in a non-farm secondary job and has earnings below the average earnings in agriculture, we consider the woman as being diversifying into low-return non-farm activities. Those who earn above this average are classified as being diversifying in high-return non-farm activities.

To investigate the second research objective which aims to assess in a broader perspective the effects of diversification strategies on household well-being, the study defines three treatment groups: i) households where only women diversify, ii) households where only men diversify and iii) households where both genders diversify. Households where no member diversifies (i.e. purely agricultural households) represent the comparison group. They are defined as households where none of the members participated in non-farm activities over the last 12 months. The outcome variable is the household well-being, captured by two different indicators: the household cash incomes per member and the household food security status. The household cash income per member is defined as the total labor income generated from farming and non-farming activities relative to the household size. Regarding the household food security status, a household is defined as food insecure if, over the past 12 months, they report that they were sometimes, often or always unable to meet their food

needs. To simplify, we rescale the food insecurity indicator into a dummy variable, taking a value of one if the answer is ‘sometimes’, ‘often’ or ‘always’ and zero otherwise.

The explanatory variables used in this study include demographic and socioeconomic factors that have been previously explored in the literature as potential determinants of diversification strategies (e.g. Démurger et al., 2010; Djido and Shiferaw, 2018 ; Van den Broeck and Kilic, 2019). These are: age, marital status, education (captured by the ability to read and write in any language), household size, number of laborers in the household, household total land cultivated area and household exposure to shocks. We also account for household core activities using the domestic workload variable, a dummy variable indicating whether or not an individual performs tasks such as cooking, cleaning and washing clothes. Next, we control for child caring activities proxied by the number of preschoolers (i.e., children below 3 years), the number of school-aged children (i.e., children below 15 years), and the number of female adults within the household which is used to capture the impact of the presence of other family members staying at home on the individual’s diversification decision. Due to their time-intensive nature, the household chores and childcare responsibilities are expected to restrict women’s availability for off-farm occupations (e.g. Qiao et al., 2015; Aryal et al., 2019). A brief description of all explanatory variables is given in Appendix (Table A1).

The descriptive statistics reported in Table 1 below summarizes the characteristics of rural women and men with and without income diversification. Of individuals with income diversification, only 29.30 percent⁶ of them are women, indicating that non-farm diversification is a male-dominated livelihood strategy. Rural women who chose to diversify spend less time on domestic tasks compared with those who do not diversify, though the difference is not significant. They also come from households with a lower number of preschoolers. This suggests that having to take care of young children tends to reduce the likelihood to engage in diversification strategies. Rural dwellers (women and men) who diversify their activities earn higher incomes and are more empowered than their counterparts who do not diversify, suggesting that diversification strategies tend to be associated with higher improved well-being at individual level. Table 1 shows that rural women and men are more likely to diversify when they are located closer to the main road. It takes on average 1.1083 and 1.141 km for women and men without income diversification to reach the nearest main road, and only 0.386 and 0.849 km for women and men with income diversification, respectively. Table 1 also reveals that rural women and men who diversify tend to belong to community with a higher level of diversification, which indicates that community networks seem to facilitate the adoption non-farm diversification strategies activities.

Table 1: Characteristics of rural dwellers with and without income diversification

Variables	Rural women			Rural men		
	Without income diversification	With income diversification	T-test Difference ^a	Without income diversification	With income diversification	T-test Difference
Time spent on domestic tasks (hours)	39.285	27.994	11.291	6.543	4.072	2.470**

⁶ 699/(699+ 1686)

	[2.264]	[9.826]		[1.107]	[0.407]	
Number of preschoolers	3.100	2.790	0.310***	2.791	2.805	-0.014
	[0.024]	[0.109]		[0.027]	[0.065]	
Number of school-aged children	3.683	3.563	0.120	3.546	3.103	0.443***
	[0.028]	[0.112]		[0.032]	[0.069]	
Monthly income (CFA)	10294.125	54786.317	4.45e+04***	44468.564	1.94e+05	1.49e+05***
	[356.775]	[3289.310]		[1706.081]	[21899.451]	
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: °The value displayed for t-tests are the differences in the means across the groups, i.e. z-test for dichotomous variables and t-test for continuous variables. ***, **, and * indicate significance at the 1, 5, and 10 percent critical. Level.. Standard errors are in [.]. Survey weights included. Source: Authors' calculations using ESPS-II data.

In Table 2 below, we observe that households with female income diversification score better for the two well-being indicators than households without income diversification (i.e. purely agricultural households). In fact, households with at least one woman adopting diversification strategies have significantly higher income levels and are less likely to be food insecure (columns 1 and 4).

This also holds true in households with male income diversification and in households with both male and female income diversification compared to households without income diversification (columns 2 and 4; columns 3 and 4). Table 3 shows that when only women diversify, households appear to have lower per capita income but are less likely to be food insecure than when only men diversify or when both men and women diversify (columns 1 and 2; columns 1 and 3). In households where both genders diversify, the income per capita tends to be higher than when men or women solely diversify.

Table 2: Well-being indicators for households with and without income diversification.

Indicators	(1) Households where only women diversify		(2) Households where only men diversify		(3) Households where both men and women diversify		(4) Households where no member diversifies	
	N	Mean/SE	N	Mean/SE	N	Mean/SE	N	Mean/SE
Food insecurity status (%)	239	11.30 [0.021]	1317	17.0 [0.010]	726	18.50 [0.014]	3206	22.40 [0.007]
Household income per capita (CFA)	239	19 142.03 [1628.26]	1317	33 673.93 [1755.13]	726	36 824.40 [2771.42]	3206	10 490.23 [338.43]

Note: Standard errors are in [.]. 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 focusing only on agriculture. However, it appears that poorer households are likely to diversify less 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.

Table 3 Household diversification strategies by per capita income quartile

	Households with female income diversification	Households with male income diversification	Households with both female and male income diversification	Households without income diversification
<i>Per capita income quartile</i>				
1st	11.30	5.09	5.65	38.58
2nd	28.03	18.83	14.19	29.79
3rd	38.08	31.28	32.64	20.68
4th	22.59	44.80	47.52	10.95

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

The findings at this stage are instructive but not conclusive because the analysis is univariate in nature and factors other than diversification can also influence the indicators of well-being. We overcome this limitation using an econometric approach in the next sections.

V. Empirical Strategy

This section follows a two-step approach to provide details of the empirical framework used in this study to assess the effects of diversification strategies on rural women's well-being and that of their households.

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

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

$$Y_i = X_i \alpha + T_i \beta + \mu_i \quad (7)$$

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 (7) 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 (7) using OLS, we may run into an endogeneity problem 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, we need to find at least one exogenous instrument that is correlated with diversification but does not influence the outcome variables. We use two instruments in this study. The first instrument is the ratio of diversification here measured as the proportion of laborers with diversified activities (i.e., combining farming and non-farming work) to the total laborers in the community. Individuals residing in more diversified communities are more likely to learn about livelihood diversification and its possible advantages. It is arguable that a higher community involvement in diversification facilitates an individual's decision to diversify as shown in Table 2 above.

The second instrument is the Distance to-all weather road, captured by the distance from the households to the nearest main road. Our data show in Table 2 that individuals living in households located closer to the main road are more likely to diversify, probably because an easier access to infrastructure services such as transport will result 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, it is also required that they do not influence women's well-being (i.e., women's

income and empowerment), except via their effects on diversification.⁷

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 adopted to assess the effects 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 captures diversification along with a vector of other independent variables as follows:

$$Y_i = \beta x_i + \theta D_i + \varepsilon_i \quad (8)$$

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: the household income per capita and the household food insecurity status.

Diversification strategies, D_i , is the main variable of interest. It is a multinomial variable of four categories with 1 corresponding to households with at least one male income diversification, 2 households with at least one female income diversification, 3 households with both female and male income diversification, and 4 households without income diversification which represents the base group for the empirical analysis. x_i includes a set of household and household head characteristics chosen on the basis of previous studies (see Qiao et al., 2015; Djido and Shiferaw, 2018 ; Van den Broeck and Kilic, 2019).

We focus 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 so, the estimates could be biased because this implies that diversification is exogenous, which might be a strong assumption in the context of rural Senegal. 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 when not controlling for observed and unobserved characteristics. To address this problem, we use a multivalued treatment model which allows multiple treatment possibilities and controls for selection bias on observed characteristics. We conduct the analysis based on the augmented inverse-probability weighting method which involves

⁷ We shall provide formal tests of the validity of the variables used as an instrument later in the document.

the use of the “teffects aipw” command in Stata⁸. 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 (2006a) approach was initially developed for estimating outcome variables with a negative binomial distribution. This allows the outcome variable to be continuous (e.g., household income per capita) or binary (e.g., household food insecurity status). The model is estimated using maximum simulated likelihood based on Halton Sequences⁹.

In the first stage, we consider that rural households are either all farmers or all diversified, allowing us to classify them into four mutually exclusive groups as described above: (i) households with at least one female income diversification; (ii) household with at least one male income diversification; (iii) household with both female and male income diversification; (iv) household without income diversification. As such, households will choose only one of the four livelihood options so identified.

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

$$V_{ij}^* = z_i' \alpha_j + \delta_j l_{ij} + \eta_{ij} \quad (9)$$

Where z_i is a vector of household and household head 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 in our analysis 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 $d_j = (d_{i1}, d_{i2}, \dots, d_{ij})$. 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

⁸ See Cattaneo (2010) and Cattaneo et al. (2013) for more information about this approach and the multivalued treatment effects models.

⁹ This is implemented in Stata using the Deb's (2009) mtreatreg command with 200 simulations.

treatment), conditional on the latent factors is:

$$Pr(d_i|z_i, l_i) = \frac{\exp(z_i' \alpha_j + \delta_j l_{ij})}{1 + \sum_{k=1}^J \exp(z_i' \alpha_k + \delta_k l_{ik})} \quad (10)$$

In the second stage of the model, we investigate the impact of diversification strategies on household well-being. The expected outcome equation is formulated as follows:

$$E(y_i|d_i x_i l_i) = x_i' \beta + \sum_{j=1}^J \gamma_j d_{ij} + \sum_{j=1}^J \lambda_j l_{ij} \quad (11)$$

Where y_i is the outcome variable (household income per capita, household food insecurity 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 control group i.e., households without income diversification. 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 outcome (household income per capita, household food insecurity status).

VI. Estimation Results

6.1. Results for the effects of diversification strategies on individual's well-being

This subsection presents the estimation results for the effects of diversification strategies on well-being across female and male samples using the two-stage least square. Table 4 below shows the results from the first stage estimates. We start reporting the binary probit estimates of the likelihood to engage into any diversification (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 towards the different livelihood diversification strategies.

At the aggregated level, the results indicate a concave relationship between age and diversification decision for both women and men. In other words, the likelihood to diversify first increases and then decreases with age, suggesting that young women and men are more likely to diversify than their adult peers. The marital status has a significant and positive coefficient, which indicates that rural women and men tend to participate more in diversification strategies after marriage. Education

(proxied by the number of adult members with at least primary education) has a positive impact on female diversification decision. This suggests, as documented in the literature, that education facilitates access to off-farm employment (e.g. Senadza ,2012; Corral and Radchenko, 2017; Dolislager et al., 2019;). The coefficient of domestic tasks is negative for rural women and positive for rural men. However, none of these coefficients is found to be statistically significant. Replacing the dummy variable of domestic task with the time spent on domestic tasks yields similar results¹⁰. Rural men living in households with more young children and female adults are more likely to adopt diversification strategies. Women's decision to diversify into the non-farm sector is not affected by the number female adults. However, the number of school-aged children and preschoolers positively influences women's likelihood to adopt diversification strategies at 5 and 10 percent level, respectively. This is not consistent with studies that find that having to perform domestic tasks limit women's time and capacity to participate in productive activities (e.g., Van den Broeck and Maertens, 2017; Aryal et al., 2018). Diversification is also negatively influenced by household size, and positively affected by labor size. That is, rural men and women living in households with smaller size and higher number of working members are more likely to engage in non-farm diversification strategies. Household land size has a positive effect on female and male diversification decision, albeit marginally. Unlike women, rural men living in households exposed to shocks are more likely to diversify into non-farm activities, but the results are not statistically significant.

In sum, compared to rural men, the aggregate estimations indicate that, young and married rural women living in households with fewer people, more educated members, more school-aged children and more working members are more likely to diversify into non-farm activities.

Distinguishing diversification strategies in terms of returns, we find that women's decision to diversify into high-return non-farm activities appears to be mostly influenced by age, education and number of laborers. Indeed, female youth and women living in households with more working members and more educated people tend to participate more in high-return diversification activities. This result is in line with Rahut and Scharf (2012) who find that education is a key determinant of diversification into more remunerative non-farm. However, none of the variables, such as domestic tasks, number preschoolers and school aged-children¹¹ seems to have a significant impact. That is, female participation in high-return diversification strategies does not seem to be constrained by household chores and child rearing obligations, which often limit their mobility and involvement in productive activities. This is consistent with findings in the childcare literature, which documents that grandparents play an important role in raising young children (see Qiao et al., 2015). Regarding rural men, we find that their decision to diversify into high-return no-farm activities is mainly determined by age, marital status, education, household size, number of female adults and laborers per household. More specifically, rural men are more likely to engage in high-return diversification activities if they are young, married, and belong to households with fewer people, more female adults and more working

¹⁰ The estimation results when using the time spent on domestic tasks are not reported for simplicity.

¹¹ We repeat our estimation using dummy variables of having preschoolers and school-aged children. The two approaches yielded very similar results.

members.

Overall, since rural women and men differ in the factors that influence their diversification decision (see Table 4), and as only 19 percent of rural women diversify into high-return non-farm activities (see Table 1), the design of gender-sensitive policies is critical to improving women's poor access to higher return non-farm activities.

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	0.00588***	0.00311***	0.00277***	0.0144***	0.00425***	0.0101***
Age square	-0.0000599***	-0.0000311**	-0.0000288***	-0.000166***	-0.0000484***	-0.000118***
Married	0.0151**	0.0128**	0.00223	0.0484***	0.000354	0.0481***
Number of educated people	0.00173**	0.000348	0.00139**	-0.00236*	-0.00165*	-0.000712
Household size	-0.00485***	-0.00300***	-0.00185**	-0.0163***	-0.00638***	-0.00992***
Carry out homework	-0.00383	-0.00195	-0.00188	0.00372	-0.000139	0.00385
Number of female	0.000592	-0.000182	0.000775	0.00834***	0.00231	0.00603***
Number of preschoolers	0.00277*	0.00186	0.000907	0.0135***	0.00892***	0.00456*
Number of school-aged children	0.00384**	0.00284**	0.00100	0.00756***	0.00467***	0.00289
Number of laborers	0.00831***	0.00614***	0.00217***	0.0164***	0.00694***	0.00941***
Total land size	0.000474*	0.000119	0.000355*	0.000752*	-0.000205	0.000956**
Shocks	-0.000682	-0.00619	0.00551	0.00722	-0.00150	0.00873
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
Instruments						
Ratio of diversification	0.528***	0.368***	0.161***	0.854***	0.317***	0.537***
Distance to all weather roads	-0.000914***	-0.000453**	-0.000461***	-0.00153**	-0.000454	-0.00107**
_cons	-0.142***	-0.0766***	-0.0650***	-0.180***	-0.0584**	-0.122***
N	15726	15726	15726	12699	12699	12699

Notes : *** Significant at 1%, ** significant at 5%, * significant at 10%. Survey weights included. Source: Authors' calculations using ESPS-II data.

Before discussing the results from the second stage estimation, we perform a set of validity tests to assess the appropriateness of the two variables used as instruments.

Notice that for an instrument to be valid, it must be relevant (i.e., being significantly correlated with the variable suspected to be endogenous) and exogenous (i.e., being uncorrelated with the error term). To check for the relevance of instruments, we use the under-identification and weak-identification tests. The results highlighted in Table A2 in Appendix strongly reject the null hypothesis of under-identification as indicated by the Kleibergen-Paap rk LM statistic. Furthermore, Table A2 reveals that the 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 percent critical value in all models. The second condition of exogeneity of instruments requires testing the overidentifying restrictions¹². 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 observe that when we address the endogeneity of diversification using the IV approach, diversification turns out to be insignificant with a negative sign (Table 5 below; 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 that there is no difference in income between rural men adopting diversification strategies and those focusing on farming alone. Diversification out of farming is not as remunerative for rural men, probably because they generally control most of the farm-related productive resources, which seems to promote agricultural intensification rather than diversification into non-farm employment.

For rural women, the OLS results in Table 6 below show that diversification has a positive and significant effect on income. At the aggregated level, rural women adopting diversification strategies earn 42089.40 CFA more than their female counterparts involved only in farming activities. Diversification into low-return non-farm activities also increases the average income that rural women earn by about 6881.60 CFA. Furthermore, we find that diversification into high-return non-farm activities has a significantly positive effect on rural women's well-being, raising their average income by 96673.80 CFA.

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 increases rural women's income by

¹² This test is possible because we have two instruments for our endogenous variable.

around 32071.90 CFA. Rural women who diversify into low-return non-farm activities also obtain higher income than their peers specialized in agriculture, with a difference of 45941.70 CFA on average. Finally, we also observe a difference in income of around 105523.40 CFA between rural women diversifying into high-return non-farm activities and those relying only on farming. As expected, high-return diversification activities have larger income-increasing effects compared with low-return diversification activities or specialization in farming.

The OLS and IV estimates differ significantly, even though the effects of diversification strategies remain positive and significant after controlling for endogeneity. That indicates that the OLS estimates suffer from selection bias on unobserved characteristics. More striking is the direction of the bias. For the last two models (Table 6; Columns 5b and 6b), the income effects increase once the endogeneity problem is addressed. The income gain increases from 6881.60 CFA in column (2b) to 45941.70 CFA in column (5b), and from 96673.80 CFA in column (3b) to 105523.40 CFA in column (6b) for the 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 rural women with more favorable initial conditions. This is a welcome finding from a gender equity perspective as one might have expected the opposite, i.e. that the effect of diversification would be larger for better endowed rural women.

A question that also is of particular interest is whether poorer rural women benefit more from diversification strategies than richer rural women. We empirically examine this issue by estimating the percentile weight regression (PWR) model developed by Araar (2016)¹³, based on the income distribution across rural individuals. This approach allows us to investigate the impact heterogeneity of diversification strategies, i.e., the extent to which the effects of diversification vary depending on income levels using the same control variables as before.

¹³ 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)	(2a)	(3a)	(4a)	(5a)	(6a)
	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)
	Aggregate diversification	Low income diversification	High income diversification	Aggregate diversification	Low income diversification	High income diversification
Diversification	128977.4***	-39237.3***	203608.8***	-25768.2	-67514.1	-41622.8
Age	4510.9***	6596.8***	4305.9***	6805.1***	6722.0***	6855.9***
Age square	-42.99**	-67.02***	-40.44**	-69.46**	-68.44**	-70.08**
Married	29413.5***	35440.2***	25874.9***	36654.9***	35433.8***	37406.3***
Number of educated people	2234.5*	1841.4*	2074.1*	1843.5*	1792.9*	1874.8*
Household size	-4296.2***	-6699.2***	-4380.5***	-6872.5**	-6883.5**	-6865.3**
Carry out homework	13190.8	12787.6	12889.4	12818.3	12720.8	12878.4
Number of female	4223.9**	5390.4***	4072.2**	5514.6***	5455.7***	5550.6**
Number of babies	2759.8	4912.0	3570.1	4914.4	5168.9	4757.1
Number of children	2116.5	3104.1*	2502.0	3102.4	3223.7	3027.4
Number of laborers	-234.8	2429.1*	-42.72	2600.7**	2645.7**	2572.4**
Total land size	1302.7*	1436.1*	1205.3	1466.9*	1433.6*	1487.5*
Shocks	-8709.5	-7104.3	-9545.3	-6803.0	-7092.7	-6624.8
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	12699	12699	12699	12699	12699	12699

Notes : *** 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)	(2b) (OLS)	(3b) (OLS)	(4b) (IV)	(5b) (IV)	(6b) (IV)
	Total income diversification	Low income diversification	High income diversification	Total income diversification	Low income diversification	High income diversification
Diversification	42089.4***	6881.6***	96673.8***	32071.9***	45941.7***	105523.4***
Age	1308.0***	1531.5***	1285.8***	1366.2***	1412.3***	1261.4***
Age square	-14.46***	-16.73***	-14.18***	-15.05***	-15.55***	-13.93***
Married	761.2	1328.2	1193.0	917.9	808.7	1172.3
Number of educated people	560.8***	633.4***	500.4***	578.8***	618.4***	488.0***
Household size	-1028.5***	-1226.9***	-1058.8***	-1081.1***	-1098.9***	-1041.4***
Carry out homework	2086.2*	1600.1	2002.9*	1957.2*	1917.8*	2044.9*
Number of female	504.0*	521.3*	450.9*	507.6*	535.0*	444.6*
Number of babies	463.4*	598.1*	502.2*	499.4*	503.1*	491.9*
Number of children	541.2*	671.1**	601.1**	576.4**	569.5*	593.0**
Number of laborers	1125.8***	1478.8***	1279.5***	1221.2***	1206.6***	1256.9***
Total land size	10.10	35.60	-2.013	16.56	26.28	-5.607
Shocks	-1406.2	-1164.4	-1889.2	-1351.8	-1089.0	-1954.3
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	15726	15726	15726	15726	15726	15726

Notes: *** 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 compute the percentiles of the outcome variable (i.e., cash income from farming and non-farming sources), we then generate the Gaussian density around the percentile of interest (i.e., the percentile weights), and finally we run the same IV approach described above by including the percentile weights. The results are illustrated in Figure 1.

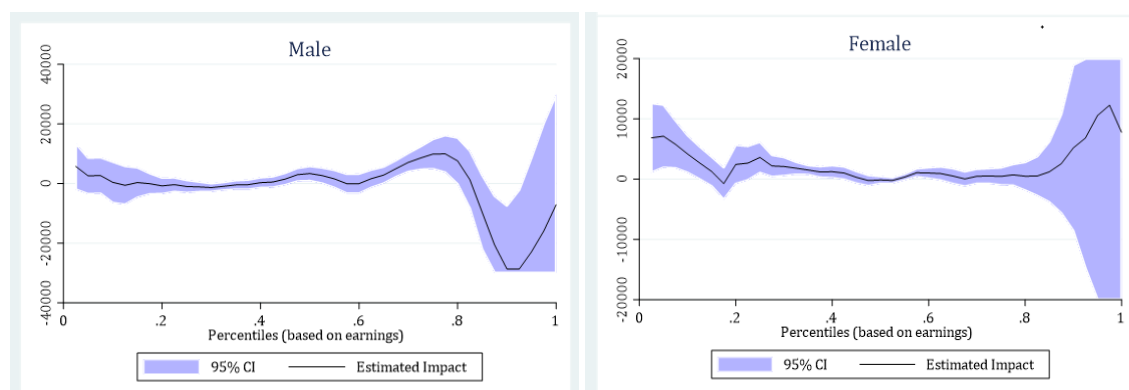


Figure 1. Impact heterogeneity of diversification strategies across gender; Sources: Authors' illustrations.

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 income level benefit more from diversification than rural men with high income level and second, that diversification improves the incomes of well-off rural women (i.e., rural women with high income level) more than it does for the poor (i.e., rural women with low income level). The findings in Table 6 suggest that diversification can be an effective tool for raising incomes of rural women. But as seen in the right panel of figure 1, female diversification is inequality-increasing 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).

Table 7 reveals that the estimates in columns (4), (5) and (6) are markedly different from those in columns (1), (2) and (3), suggesting that the OLS results suffer from endogeneity bias. The direction of the bias is also worth considering. The effects of diversification increase once the endogeneity issue is addressed. This indicates that diversification seems to be more beneficial for rural women with less favorable conditions, and that the diversification effects would be underestimated when not controlling for the unobserved characteristics. The OLS estimates highlight smaller or no effects of diversification strategies on rural women's empowerment (columns (1) to (3)). Whereas, in all the models, diversification has significantly positive effects once the IV approach is employed. Regardless of whether rural women diversify into low or high return non-farm activities, we can note that diversified rural women are by far more empowered than their female counterparts engaging only in farming. The effects of diversification strategies on rural women's empowerment vary depending on the types

of non-farm activities. Rural women are much more empowered when they diversify into high-return non-farm activities than when they participate in low-return diversification activities (columns (5) to (6)). These findings suggest that high-return diversification activities appear to be one of the key opportunities for rural women to significantly empower themselves. As highlighted in Table 4 above, women’s ability to engage in high-return diversification strategies is not constrained by household chores and child rearing obligations, which is good news for policy-makers interested in promoting the development of high-return nonfarm rural sectors.

Table 7: Effects of diversification rural on women's empowerment

	(1)	(2)	(3)	(4)	(5)	(6)
	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Diversification	0.0833	-0.183*	0.530***	0.933***	1.344**	3.028**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
N	15726	15726	15726	15726	15726	15726

Notes : *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Model 1 refers to Aggregate diversification, Model 2 is about 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 proceed stepwise. We first report the results of the OLS or Logistic regression depending on the indicator we use to measure the household well-being (i.e., household income per capita or household food insecurity status). In a second step, we show the results from the augmented inverse-probability weighting (AIPW) method, and in the last step we provide the estimates obtained from the two-stage multinomial endogenous treatment (MET) model. Note that the first stage results are not presented here since the analysis follows the same analogy as that conducted 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 (Tables 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

Models	Group 1 Households with female income diversification			Group 2 Households with male income diversification			Group 3 Households with male and female income diversification		
	(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)
Household income per capita	6043.9***	6109.22***	5247.4***	21885.8***	22023.78***	17459.6***	22702.1***	25382.33***	18449.5***
Household food insecurity	-1.074***	-.1083***	-0.224***	-0.330**	-.057***	-0.126***	-0.206	-.030**	-0.102**

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Sample size is 5488. Households without income diversification represent the comparison group, while the treatment groups are: i) households with female income diversification, ii) households with male income diversification and iii) household with both female and male income diversification. Survey weights included. Source: Authors' calculations using ESPS-II data.

The results in Table 8 provide clear evidence of a significant difference in household income per capita 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 take the MET estimates reported in columns (3), (6) and (9) the preferred regressions as they provide more reliable results.

We find that female diversification strategies increase the household income per capita by 5247 CFA and reduce the likelihood of being food insecure by roughly 22 percent compared to non-diversified households. Male diversification strategies also increase household income per capita by about 17460 CFA and lower a household's likelihood of being food insecure by 12.6 percent. The results further indicate that when both genders diversify, they increase the income per capita by about 18449 CFA and reduce the mean probability of being food insecure by 10.2 percent.

A closer examination of Table 8 reveals some interesting findings. We see that irrespective of the indicator used, households adopting diversification strategies do better in improving their well-being than households where no member diversifies (i.e. purely agricultural households). Such a finding provides evidence that combining farm and non-farm activities are required to boost incomes and reduce household vulnerability to food insecurity. This corroborates recent studies (Frelat et al., 2016; Alogo Loison, 2019) emphasizing that while development in the agricultural sector can have a great impact on poverty reduction, relying purely on agriculture will not be enough to lift rural people out of poverty. The second important result is that the link between diversification and household food security is more pronounced when only women diversify. That is, the household is most likely to be food secure when only women diversify than when only men diversify, or when men and women jointly diversify. This is consistent with the general observation that women tend to use a greater share of their income to meet daily household expenses than men (e.g., Duflo, 2012; Akter et al., 2017). Another interesting result is that diversification is more important in raising the household income per capita when both genders diversify than when only women or men adopt diversification. This gain in living standards reflects the large income-increasing effects of female 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 examine the heterogeneity of the impact of diversification strategies at the household level based on the distribution of the outcome variables. We use the 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 household income per capita is more significant when both genders diversify than when only men or women diversify. The diversification effects also decrease across the income distribution. This implies that poor households benefit more from diversification strategies than the non-poor, which indicates that when men or women living in poor households diversify in the non-farm sector, they increase household income per

capita more than do those in non-poor households.

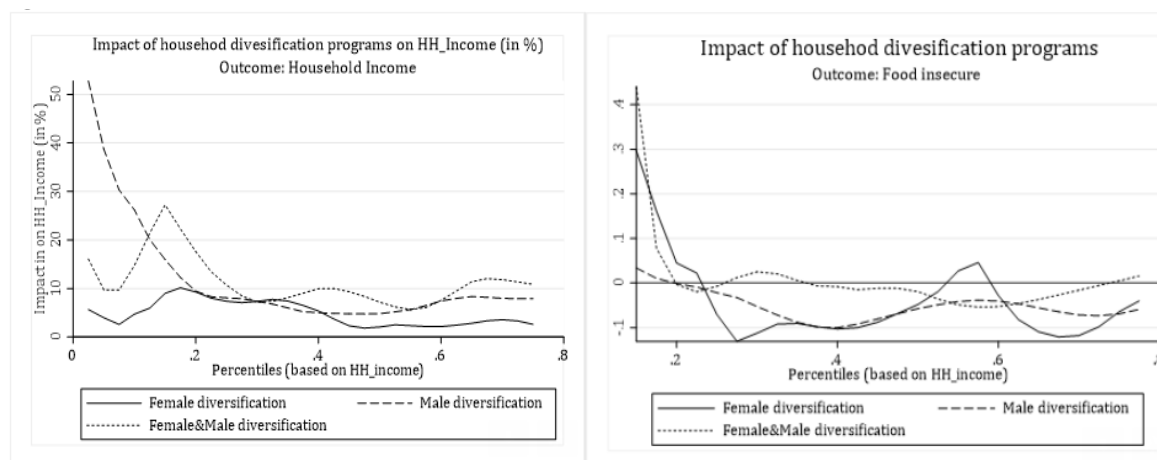


Figure 2. Impact heterogeneity of diversification strategies across household groups; Sources: Authors' illustrations.

Figure 2 also shows that the impact of diversification on food security differs significantly across poor and non-poor households (right panel). Poor households tend to be less food insecure when only men diversify, while in non-poor households, diversification is more important in decreasing the likelihood of being food insecure when only women diversify. We can also see from Figure 2 that the diversification's impact on food security diminishes across the distribution. Obviously, food insecurity is not an issue for those who are not initially poor because of their higher incomes.

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

VII. Conclusions and policy implications

In this study, we used data from the second Poverty Monitoring Survey to provide novel insights into the gender-differentiated impact of diversification strategies in rural Senegal. The first point that our research tries to investigate is what variables, at the individual and household level, determine female and male participation in non-farm diversification strategies. Findings reveal that rural women, compared to men, are more likely to engage in diversification into the non-farm sector if they are young, married, and belong to households with fewer people, more young children and more working members. Distinguishing the non-farm activities in terms of returns, we find that women's decision to diversify into high-return non-farm activities is mostly determined by age and the number of working members, rather than by education, domestic tasks or number young children. That is, women's ability to engage in (high-return) diversification strategies is not constrained by household chores and child rearing obligations. The second point that the study attempts to examine is whether diversified rural women and men are better off than those relying only on farming activity. We find mixed results on the importance of diversification strategies across gender. On the one hand, while diversification is a male-dominated activity, we find no difference in income between rural men adopting diversification strategies and those focusing only on farm work. On the other hand, we find that regardless of whether rural women diversify

into low or high return non-farm activities, rural women who combine farming and non-farming earn by far higher incomes and are much more empowered than their female counterparts engaging only in farming. Finally, the third point that the study attempts to analyze is the conditions under which household well-being is most likely to be improved. We find that households have significantly higher income levels when both genders diversify, but they are most likely to be food secure when women solely diversify.

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 to support female 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 poverty in rural Senegal. To this end, an adequate technical support should be offered to women involved or not in diversification in order to share experiences and good practices. This can be done in local languages for better outreach and training of male and female-headed households on diversification into high-return non-farm activities.

Next Steps

- Revise the final report
- Come up with a working paper
- Submit the paper to a journal:
 - Journal of Rural Studies
 - World Development

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Appendices

Table A1. Explanatory variables definition.

Definition of variables	Description
Age	Age in full years
Married	1 if married (monogamous or polygamous)
Literacy	1 if individual can read and write in any language
Number of educated people	Number of adult members with at least primary education
Household size	Number of persons in the household
Domestic workload	1 if individual performs domestic tasks such as cooking, cleaning and washing clothes
Number of female	Number of female adults in the household age 15 to 65 years
Number of preschoolers	Number of children in the household below 4 years
number of school-aged children	Number of children in the household aged 6 to 14 years
Number of laborers	Number of workers in the household
Farm size	size of cultivated area of the household in hectares
Shocks	1 if household experienced a shock. The 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 to the nearest highway from the households in which the individual resides
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	Rural women			Rural men		
		Aggregate diversification	Low-return diversification	High-return diversification	Aggregate diversification	Low-return diversification	High-return diversification
Instrument Relevance tests							
Model is not identified (Under-identification)	Kleibergen-Paap rk LM statistic	194.733*** (0.01)	135.074*** (0.01)	52.829*** (0.01)	226.143*** (0.01)	80.375*** (0.01)	122.073*** (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							
Excluded instruments are uncorrelated with the error term and correctly excluded from the estimated equation	Sargan-Hansen	0.431	0.605	0.137	1.201	1.163	1.223
	J-statistic	(0.5115)	(0.4367)	(0.7109)	(0.2732)	(0.2809)	(0.2688)

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: Author's calculations using ESPS II data

Table A3. Effects of diversification rural on womens' empowerment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	(OLS)	(OLS)	(OLS)	(IV) 1st STAGE	(IV) 2 nd STAGE	(IV) 1st STAGE	(IV) 2 nd STAGE	(IV) 1st STAGE	(IV) 2 nd STAGE
	Aggregate diversification	Low income diversification	High income diversification	Aggregate diversification	Aggregate diversification	Low income diversification	Low income diversification	High income diversification	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 square	-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 females	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***
<i>Instruments</i>									
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) (2) (3) (4) (5)

	(MCO)	(MET) 1 st Stage	(MET) 1 st Stage	(MET) 1 st Stage	(MET) 2 nd Stage
Gender of household head (female=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 square of household head	-2.12	0.0000743	0.000231	-0.0000109	-2.026
<i>Education of household head (ref no educated)</i>					
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 female	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 female income diversification	6043.9***				5247.4***
Households with male income diversification	21885.8***				17459.6***
Households with both female and male 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
Insigma					10.646***
lambda 1 (Household with female income diversification)					904.20***
lambda 2 (Household with male income diversification)					5198.42*
lambda 3 (Households with both female and male income diversification)					4903.17**

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Sources: Author's calculations using ESPS II data

Table A5. Effects of diversification on household well-being (i.e. household food insecurity)

(1) (2) (3) (4) (5)

	(LOGIT)	(MET) 1 st Stage)	(MET) 1 st Stage)	(MET) 1 st Stage)	(MET) 2 nd † Stage)
Gender of household head (female=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 square of household head	0.000254	0.0000593	0.000226	-0.0000223	0.0000386
<i>Education of household head (ref no educated)</i>					
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 females	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 female income diversification	-1.074***				-0.224***
Households with male income diversification	-0.330**				-0.126***
Households with both female and male 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

Insigma	-1.110***
lambda 1 (Household with female income diversification)	0.111***
lambda 2 (Household with male income diversification)	0.105***
lambda 3 (Households with both female and male income diversification)	0.0908**

Notes: *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Sources: Author's calculations using ESPS II data

