



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*



**Division of  
Bioeconomics**

DEPARTMENT OF EARTH AND  
ENVIRONMENTAL SCIENCES  
KU Leuven - BELGIUM



# Understanding the importance of wage employment for rural development: Evidence from Senegal

Kaat VAN HOYWEGHEN, Goedele VAN DEN BROECK  
and Miet MAERTENS

Bioeconomics Working Paper Series

Working Paper 2018/03



**KU LEUVEN**

Division of Bioeconomics  
Department of Earth and Environmental Sciences  
University of Leuven  
Geo-Institute  
Celestijnenlaan 200 E – box 2411  
3001 Leuven (Heverlee)  
Belgium  
<http://ees.kuleuven.be/bioecon/>

# Understanding the importance of wage employment for rural development: Evidence from Senegal

Kaat VAN HOYWEGHEN <sup>1</sup>, Goedele VAN DEN BROECK <sup>1</sup> and Miet MAERTENS <sup>1</sup>

## Abstract

The literature on the rural non-farm economy and non-farm employment often neglects agricultural wage employment. This neglect is rooted in the idea that such employment cannot significantly contribute to household welfare and rural development because it is a low-return and insecure type of employment. In this paper we specifically focus on off-farm wage employment, disentangle different employment sectors, and estimate the impact on household welfare. We use two-round panel data from Senegal, and fixed effects regressions and differencing techniques. We use static as well as intertemporal measures of welfare. We find that entry into wage employment increases per capita income with 140%, smooths income significantly, reduces the likelihood to be poor with 34% points and the likelihood to become or remain poor with 16%. Despite substantially lower wages for casual and agricultural employment, we find substantial income-enhancing and poverty-reducing effects of such employment. Casual employment is found to at first smooth incomes and to then boost incomes either through upward employment mobility to higher-return jobs or through relaxing investment constraints and increased income from self-employment. We conclude that jobs are important for rural development as they both smooth and boost rural incomes; that the agricultural sector can be an important source of jobs; and that casual jobs can be an important source of upward income mobility. The paper corroborates claims on the importance of the rural non-farm economy but refutes the idea of casual or agricultural employment not contributing to household welfare and rural development. This calls for a reconsideration of the definition of the rural non-farm economy to include agricultural wage employment as a full component.

**Key Words:** wage employment, labor mobility, rural development, welfare dynamics, panel data, Sub-Saharan Africa

**JEL classification:** I32, J43, J46, O15

**Corresponding author:** [kaat.vanhoyweghen@kuleuven.be](mailto:kaat.vanhoyweghen@kuleuven.be)

## Acknowledgements

This work was supported by an FWO (Research Foundation - Flanders) SB scholarship. We thank Hannah Pieters and the University of Gaston Berger in Saint-Louis, Senegal, for their highly appreciated assistance in data collection.

---

<sup>1</sup> Bio-Economics Division, Department of Earth and Environmental Sciences, University of Leuven, Belgium

# Understanding the importance of wage employment for rural development: Evidence from Senegal

## 1 Introduction

Despite the fact that the Millennium Development Goal on poverty reduction has been met – the global poverty headcount ratio has been halved since 1990 – the UN reports that intensified efforts are required to boost incomes, build resilience and eradicate poverty completely (United Nations, 2017). A focus on Sub-Saharan Africa (SSA) is indispensable as the absolute number of poor still increases in SSA, despite a drop in the poverty headcount ratio<sup>2</sup> from 56% in 1990 to 41% in 2013 (Beegle, Christiaensen, Dabalén, & Gaddis, 2016). In 2013, SSA accounted for more than half of the world's extreme poor (World Bank, 2016). Scholars increasingly acknowledge that a successful structural transformation of the rural agrarian society is necessary for the eradication of poverty (Barrett, Carter, & Timmer, 2010; Barrett, Christiaensen, Sheahan, Shimeles, & Dyson, 2017). Structural transformation can be defined as the reallocation of labor from a low-productivity sector (often smallholder agriculture) to a higher-productivity sector, such that low-income societies become high-income societies (McCullough, 2017). The development of a rural non-farm economy (RNFE) and a formal rural employment sector are considered important pathways for structural transformation (Barrett et al., 2010, 2017; Haggblade, Hazell, & Reardon, 2007).

A vast body of literature provides insights into the importance of off-farm employment and rural non-farm businesses for rural development and household welfare. Studies use varying definitions of the RNFE, a melting pot of economic activities other than self-employment in agricultural and livestock production, including wage employment off the own farm and self-employment in non-farm sectors (Haggblade, Hazell, & Reardon, 2010). In this literature, casual and agricultural wage employment is often not considered in the definition of the RNFE, in empirical measures of RNFE participation and in the resulting policy debate. This exclusion might to some extent be related to data limitations<sup>3</sup> – but is also rooted in an intrinsic idea that agricultural wage employment is a low-remunerative, marginal and insecure source of income that cannot significantly contribute to household welfare and rural development (Matsumoto, Kijima, & Yamano, 2006; Oya, 2013). Yet, if agricultural wage employment is the most important off-farm employment sector for the rural poor – because of the lower capital requirements for entry (Adjognon, Liverpool-Tasie, de la Fuente, & Benfic, 2017; Davis et al.,

---

<sup>2</sup> Based on the international extreme poverty line of \$1.9 a day.

<sup>3</sup> Casual wage employment in the agricultural sector is often semi- or informal and might be underreported by respondents if it is not considered decent employment (Oya, 2013).

2010; P. Lanjouw & Murgai, 2009) and lower reservation wages of poor households – neglecting this sector may result in an underestimation of the contribution of the RNFE to boost welfare in rural communities and failure in identifying effective policies for eradicating poverty. A comprehensive understanding of the importance of the RNFE for structural transformation, rural development and welfare mobility requires a more careful consideration and disentangling of different employment sectors in empirical studies.

In this paper we specifically focus on off-farm wage employment, disentangle different employment sectors, and estimate the impact on household welfare. We use household-level data from a balanced panel of 461 households and two survey rounds conducted in 2013 and 2016 in Senegal. The off-farm employment sector in the study region is diverse and dynamic, which allows us to make an important contribution to the empirical literature on rural employment. We have detailed data on all types of wage employment and in our analysis we disentangle between agricultural and non-agricultural wage employment, between casual and year-round wage employment, and between short-term and long-term wage employment. Disentangling different employment sectors allows us to better understand the effects of wage employment on the poorest segment of the rural population, as the poor are most intensively involved in casual work and agricultural wage employment (Davis et al. 2010). The use of panel data is an advantage – the literature on rural wage employment and welfare lacks panel data and conclusive evidence on causal relations, especially for Sub-Saharan Africa (Haggblade et al., 2010) – and allows us to consider dynamics and long-term effects. A substantial share of the employment dynamics in our sample comes from entry into wage employment and moving up from casual to year-round employment. This makes it possible to single out entry into and exit from employment, resulting in stronger and more comprehensive results. Moreover, we use four different indicators to measure household welfare: household income, poverty, variance of income, and vulnerability to poverty. Next to the more common static measures of welfare, i.e. household income and monetary poverty, we include dynamic, intertemporal measures of poverty, i.e. income variability and vulnerability. The former measure relates to the variance of income and the latter is defined as the probability that the future income of a household falls below a predefined poverty line. Despite its importance, available empirical research on vulnerability to poverty and its determinants is still very limited (Klasen & Waibel, 2014). The combination of an ex-post (income, variability in income and poverty dynamics) and ex-ante (vulnerability) assessment of welfare will result in a more holistic approach to understand the importance of wage employment for household welfare and rural development.

The remainder of this paper is structured as follows. In section two, we review the empirical literature on rural wage employment and vulnerability. Section three starts with a description of the research area and data collection, followed by a discussion of the employment classification and the different welfare indicators used in analysis, and an explanation of the econometric models. In section four, we provide descriptive statistics on employment and household welfare, and present regression results for the average effects of wage employment on different welfare indicators as well as the welfare effects of different types of wage employment. We discuss the findings in section five, and conclude in section six.

## **2 Literature review**

### **2.1 Rural employment**

The available literature on rural employment includes studies on the implications of participation in RNFE activities in general, and studies on the welfare effects of non-farm wage employment and agricultural wage employment respectively.

First, studies on RNFE activities usually do not distinguish between self- and wage-employment in rural non-farm sectors, and might or might not include agricultural wage employment off the own farm in the definition of the RNFE. Comprehensive literature reviews and cross-country analyses reveal that the RNFE is a highly heterogeneous collection of activities (e.g. Barrett, Reardon, & Webb, 2001; Haggblade, Hazell, & Reardon, 2007; Davis et al., 2010; Winters, Essam, Zezza, Davis, & Carletto, 2010; Aloba Loison, 2015). RNFE activities range from small-scale one-person non-farm businesses to large-scale operations run by multinational firms, and entail self-employment as well as wage employment activities. The main argument in this literature is that the RNFE is an important driver of upward income mobility (Haggblade et al., 2007; J. O. Lanjouw & Lanjouw, 2001; Reardon, 1998; Reardon, Berdegue, & Escobar, 2001), but can also lead to increased inequality because of capital or skill barriers for the poorest households (Babatunde & Qaim, 2009; Bezu, Barrett, & Holden, 2012; Corral & Reardon, 2001; Lay, Mahmoud, & Michuki M 'mukaria, 2008). Without a clear distinction between the different RNFE activities, it is unclear which activities are inclusive or exclusive towards the poor. A disentanglement of the RNFE is hence essential to understand its potential to increase welfare and reduce inequality.

An additional shortcoming in the existing RNFE literature is that studies are mostly based on cross-sectional data, which makes it difficult to consider dynamics and unravel causality. Only a few studies use panel data and rigorous econometric modelling to analyze the impact of RNFE participation on households' welfare. Kijima & Lanjouw (2005) use three rounds of panel data to show that the development of an RNFE sector in India pushes agricultural wages upwards, thereby having an indirect welfare increasing effect on rural households. Yet, they find no direct effect on the reduction of poverty. Bezu et al. (2012) show with six rounds of panel data that the RNFE in Ethiopia offers improved welfare prospects, both for poor and well-off households. Nonetheless, they find that non-poor households face higher returns than poor households, pointing to a possible inequality increasing effect of the RNFE. Other panel data studies reveal indeed that typically the poor do not have access to better paid, secure and high-productive

RNFE activities, since they require significant human capital and investments (Adjognon, Liverpool-Tasie, de la Fuente, et al., 2017; Cunguara, Langyintuo, & Darnhofer, 2011).

Second, studies have focused on non-agricultural wage employment in particular. Linked to the RNFE literature, studies show that participation in non-agricultural wage employment often leads to direct upward income mobility and poverty reduction, however again excluding the poorest from participating in better remunerated activities (Imai, Gaiha, & Thapa, 2015; Jonasson & Helfand, 2010; P. Lanjouw & Murgai, 2009; Scharf & Rahut, 2014). In addition to the direct welfare increasing effects, the literature on non-agricultural wage employment often focusses on possible indirect welfare increasing effects. On the one hand, participation in non-agricultural wage employment stabilizes household income or consumption when faced with downward income or consumption shocks (Cunguara et al., 2011; Ito & Kurosaki, 2009; Kijima, Matsumoto, & Yamano, 2006; Mathenge & Tschirley, 2015; Rose, 2001). On the other hand, participation in non-agricultural wage employment relaxes farmers' liquidity constraints, inducing investments on the household farm (Adjognon, Liverpool-Tasie, & Reardon, 2017; Oseni & Winters, 2009; Stampini & Davis, 2009; Takahashi & Otsuka, 2009).

Third, evidence on the impact of wage employment in the agricultural sector is more scarce. Agricultural wage employment can roughly be split up in two main categories: wage employment in the agribusiness sector and wage employment in the informal sector. A growing number of studies confirm the income increasing effect of agribusiness wage employment (Herrmann & Grote, 2015; Maertens, Minten, & Swinnen, 2012; Maertens & Swinnen, 2009; Van den Broeck, Swinnen, & Maertens, 2017). Other authors are more critical about the welfare effects of agribusiness wage employment, mainly because of low wages, poor working conditions and casualization of the workforce (Barrientos, Gereffi, Posthuma, Mayer, & Pickles, 2011; Nelson, Martin, & Ewert, 2007; Schuster & Maertens, 2016; Tallontire, Dolan, Smith, & Barrientos, 2005). Most of the evidence on the impact of agricultural wage employment in the informal sector, such as ganyu labor in Malawi, shows that because of the extremely low wages and demanding working conditions, often the poorest, food insecure households use this type of employment as a short-term fix to seasonal harvest variation, famine, or other downward shocks. Scholars argue that this low-risk, low-return employment, while presumably lowering risk and vulnerability, paradoxically pushes poor households into a spiral of destitution (Fahy Bryceson, 2002; Kerr, 2005; Whiteside, 2000). Others contest this view, arguing that the supply of ganyu labor does not necessarily have a negative effect on the households' farm production and productivity. They show that ganyu labor could represent an



important source of additional income that can be used for investments on the farm (Fink, Kelsey, Masiye, Jack, & Masiye, 2014; Orr, Mwale, & Saiti-Chitsonga, 2009).

Despite a large body of literature on the RNFE, non-agricultural wage employment and agricultural wage employment, and its implications for rural development, a comprehensive assessment of overall rural wage employment, disentangling and integrating different employment types and sectors, is lacking. In this study, we consider off-farm wage employment in general, disentangle different employment sectors, and estimate the heterogeneous impact on household welfare.

## **2.2 Vulnerability**

Poverty is at the same time dynamic, with people moving out of poverty or falling into poverty, and steady, with people being trapped in poverty. Understanding both current poverty and the risk of falling into or being trapped into poverty is argued to be indispensable for adequate policy-making for eradicating poverty (Cahyadi & Waibel, 2015). Vulnerability is a useful intertemporal measure of welfare, which requires framing households' welfare in terms of the forward looking distribution of income or poverty outcomes. In the last two decades, a considerable amount of work has been done on the conceptual and theoretical underpinnings of vulnerability (Bogale, 2012; Celidoni, 2013, 2015; Chaudhuri, Jalan, & Suryahadi, 2002; Dutta, Foster, & Mishra, 2011; Hoddinott & Quisumbing, 2010; Hoogeveen, 2005; Klasen & Waibel, 2013; Ligon & Schechter, 2003; Povel, 2014; Pritchett, Suryahadi, & Sumarto, 2000).

There is, however, a lack of empirical studies that implement the concepts and theories of vulnerability, especially in impact studies. Most impact evaluation studies use static and ex-post income or poverty indicators to measure welfare and assess the welfare implications of policies and investments. To the best of our knowledge only three studies include an indicator of vulnerability in assessing the welfare implications of participation in RNFE activities and rural employment. Imai (2011) finds that governmental schemes such as Rural Public Works and Food for Work Programs in India, are able to significantly decrease poverty, vulnerability and undernutrition. Imai et al. (2015) reveal that participation in RNFE activities reduces poverty and vulnerability in Vietnam and India. Nonetheless, they confirm that activities requiring higher levels of human capital are more likely to have larger poverty and vulnerability reducing effects. Zereyesus et al. (2017) find that participation in RNFE activities in Ghana significantly increases the future expected food consumption of households, thus reducing households' vulnerability to food poverty.

### **3 Methods**

#### **3.1.1 Data**

The research is conducted in the region of Saint-Louis, located in the Northern Sahel part of Senegal. This region experiences increasingly diverse wage employment opportunities, both in the agricultural and the non-agricultural sector. The region of Saint-Louis is one of the main horticultural export regions in Senegal, and agribusiness companies are important agricultural wage employers in the area. The region is attractive for agribusiness investments because of the availability of land – which the companies lease from the rural communities – and the presence of the Senegal River delta for irrigation water. Laborers are primarily sourced from the villages surrounding the companies. In 2016, around 4,500 casual and low-skilled workers were employed on daily or seasonal basis to work on the fields or in the conditioning stations, and an additional 800 year-round workers for white collar jobs and blue collar jobs requiring some education. Next to the boom in agribusiness wage employment, there exists a wide variety of non-agricultural wage employment opportunities for rural households, most likely driven by the relative closeness of the research area to the city of Saint-Louis. This non-agricultural wage employment is highly diverse, the most common jobs being taxi driver, functionary, mason, merchant and housemaid. These jobs can be low- or high-skilled, on a casual or year-round basis.

We collected two rounds of quantitative household survey data, in 2013 and 2016. The 2013 sample includes 500 households in 34 villages (three rural communities; Diama, Gandon and Fass), selected through a two-stage stratified random sampling procedure. In the first stage, we stratified villages according to their distance to the road, and randomly selected within the strata with an oversampling of villages closer to the road. In the second stage, we stratified households (in the sampled villages) according to whether or not members of the household are employed in the agribusiness sector, and randomly selected within the strata with an oversampling of households with agricultural wage employment. The 2016 sample includes 464 of the original 500 households, which corresponds to an attrition rate of 7.2%. We consider attrition to be random since there are no significant differences in observable characteristics between resampled households and retreated households. After dropping three households because of outlying data, the final sample consists of a balanced panel data set of 461 households.

A structured quantitative questionnaire was used to collect household-level data on farm production, land and non-land assets, and living conditions, and individual-level data on demographic characteristics and employment. In order to be able to compare income and poverty over time, the two questionnaires were set up in the same way. The surveys were

implemented with a team of trained enumerators, tablets and computer-assisted personal interviewing software.

### **3.1.2 Employment classification**

We consider wage employment to comprise all activities where a person is hired and performs labor in return for a fixed monthly salary, an hourly or daily wage, or a fixed piece wage rate. In our analysis households who are not wage employed – these households mainly gain income from agricultural and non-agricultural self-employment – are considered the base category. We use four different classifications of wage employment (summarized in table A1 in appendix). First, we consider wage employment in general (*EMPL*), to look at the overall effect of wage employment. Second, we distinguish between wage employment in agricultural and non-agricultural wage employment. Agricultural wage employment (*AGR\_EMPL*) is defined as any job in the agricultural or agribusiness sector, and a household is included when at least one member is agricultural wage employed during the 12 months prior to the survey – consistent with the terminology of Barret et al. (2001). Non-agricultural wage employment (*NONAGR\_EMPL*) is defined as any job in any sector that is not agriculture or agribusiness, and a household is included when at least one member is non-agricultural wage employed. These categories are not mutually exclusive as households can belong to both categories – as is the case for 32 and 65 households in 2013 and 2016 respectively. Third, we distinguish between casual wage employment (*CASUAL\_EMPL*) and year-round wage employment (*YEAR\_EMPL*). A household belongs to the first group when all employed household members, whether in agricultural or non-agricultural wage employment, work on a daily or seasonal basis. A household belongs to the second group if at least one employed household member has a year-round or fixed employment. These categories are mutually exclusive. Fourth, we create a categorical variable (*TRANS\_EMPL*) reflecting the intertemporal dynamics (transitions) of employment in the period 2013-2016. The variable contains nine groups: 0/ “never wage employed” (the base category); 1/ “entry into casual employment”; 2/ “always casual employed”, 3/ “transition from casual to year-round employment”, 4/ “entry into year-round employment”, 5/ “always year-round employed”, 6/ “transition from year-round to casual employment”, 7/ “exit from casual employment”, and 8/ “exit from year-round employment”.

### **3.1.3 Welfare indicators**

We calculate four different welfare indicators. The first indicator is the log of per capita household income (Income), specified in real terms at 2016 price levels<sup>4</sup> and using the modified

---

<sup>4</sup> IMF data on consumer price indices are used to convert nominal to real income.

OECD adult equivalence scale<sup>5</sup>. Per capita income  $I_{per\ capita_{i,t}}$  of household  $i$  at time  $t$ , is derived taking into account income from crop production, livestock rearing, agricultural wage employment, non-agricultural wage employment, non-agricultural self-employment, and non-labor sources of income such as remittances or government transfers (equation 1).

$$I_{total_{i,t}} = I_{crop_{i,t}} + I_{livestock_{i,t}} + I_{agri\ wage_{i,t}} + I_{non-agri\ wage_{i,t}} + I_{self-empl_{i,t}} + I_{non-labour_{i,t}}$$

$$I_{per\ capita_{i,t}} = \frac{I_{total_{i,t}}}{adult\ equivalent\ household\ size} \quad (1)$$

The second indicator is a dummy variable  $P_{i,t}$ , that measures whether or not the per capita income of household  $i$  falls below the national rural poverty line of Senegal<sup>6</sup>  $z$  at time  $t$  (equation 2) – a measure of monetary poverty (Poverty):

$$P_{i,t} = 1 \text{ if } I_{per\ capita_{i,t}} \leq z$$

$$= 0 \text{ otherwise} \quad (2)$$

The third indicator  $Var_{i,t}$ , is the variance of the idiosyncratic component of household income (Variance of income). As proposed by Chaudhuri et al. (2002), we estimate an income equation based on observable characteristics (equation 3)<sup>7</sup> and obtain the residuals  $\hat{\varepsilon}_{i,t}$ . The squared residuals  $\hat{\varepsilon}_{i,t}^2$  are the variance of (the idiosyncratic component of) income (equation 4). As the error term is assumed not to be constant or heteroskedastic, three-step feasible generalized least squares (FGLS) estimation is used to estimate equation 3 and obtain consistent and efficient estimates of the error term.

$$I_{i,t} = \alpha X_{i,t} + \beta D_j + \varepsilon_{i,t} \quad (3)$$

$$Var_{i,t} = E(\hat{\varepsilon}_{i,t}^2) - \{E(\hat{\varepsilon}_{i,t})\}^2 = (\hat{\varepsilon}_{i,t})^2 \quad (4)$$

$X_{i,t}$  is a vector of household characteristics, including the age, gender, civil state, ethnicity and level of education of the household head, the number of dependent and working-age (18 to 65 years old) household members, and the share of literate workers in the household as indicators for human capital of the household; and total landholdings, the number of tropical livestock units and its square, and the number of income sources to control for productive assets.  $D_j$  is a

---

<sup>5</sup> The modified OECD adult equivalence scale assigns a value of 1 to the household head, 0.5 to each additional adult member and 0.3 to each child – and is most commonly used in the context of rural areas in developing countries.

<sup>6</sup> 221,208 FCFA per capita per year in 2011 (Gouvernement Sénégalais, 2014), inflated to 2016 prices using the IMF consumer price indices.

<sup>7</sup> Separately implemented for 2013 and 2016, to maximize the explanatory power of the regressions.

vector of village dummies to control for covariate shocks. A large variance of income indicates that households face difficulties to smooth their income.

The fourth indicator is a measure of vulnerability. We follow the method proposed by Chaudhuri et al. (2002) which is based on expected poverty. Vulnerability is formally defined as the probability that the future income  $I_{i,t+1}$  of household  $i$  in period  $t+1$  will fall below the poverty line  $z$  (equation 5):

$$V_{i,t} = \Pr(I_{i,t+1} \leq z) = \Phi \left( \frac{z - \hat{I}_{i,t}}{\sqrt{\hat{\varepsilon}_{i,t}^2}} \right) \quad (5)$$

As future income is unobserved, vulnerability is derived from the expected income  $\hat{I}_{i,t}$  and variance of income  $\hat{\varepsilon}_{i,t}^2$ , and the cumulative density function  $\Phi$  (equation 5). The expected income  $\hat{I}_{i,t}$  and variance of the income  $\hat{\varepsilon}_{i,t}^2$  are estimated from equation 3. Vulnerability is a continuous variable ranging from 0 to 1, or from 0% to 100%, and expresses the chance for a household to be poor in the next years. Households with a high vulnerability level may be households who are currently poor and are likely to remain poor as well as households who are currently not poor but are very likely to fall into poverty. We use the continuous distribution of the vulnerability measure instead of a binary distinction between vulnerable and non-vulnerable households as this contains more information and does not require an arbitrary decision on the vulnerability cut-off point, which can reduce the predictive performance of the vulnerability measure (Hohberg, Landau, Kneib, Klasen, & Zucchini, 2018).

This method allows us to estimate vulnerability in the absence of longitudinal data on risks and shocks, but is based on a number of assumptions. First, it is assumed that the present variance of the income over households in the sample reflects the variance in income for individual households over time. This is the case when some households in the sample encounter positive shocks and other negative ones. However, this implies that we rule out unobservable sources of disturbance in income over time. Second, unobservable sources of recurring shocks are ruled out by the assumption that shocks are identical and independently distributed per household over time. Third, the method assumes that there are no aggregate shocks over time, such that uncertainty about future income is only explained by the idiosyncratic shocks households face (Chaudhuri et al., 2002). Despite these rather strong assumptions, this method has been shown – through Monte Carlo simulations estimated by Ligon & Schechter (2004) – to outperform other vulnerability measures when only cross-sectional or short panel data are available and income is measured with low error. Previous studies implemented this method to assess households' vulnerability to poverty in Madagascar (Günther & Harttgen, 2009), Vietnam

(Imai, Gaiha, & Kang, 2011) and China (Ward, 2016), and to assess households' vulnerability to food insecurity in Ethiopia (Bogale, 2012) and Ghana (Zereyesus et al., 2017).

### 3.1.4 Econometric analysis

To analyze the impact of wage employment on household welfare dynamics, we use two different sets of models and techniques. First, we estimate fixed effects regressions of the following type:

$$Y_{i,t} = \gamma EMPL_{i,t} + \delta X_{i,t} + \zeta V_{i,t} + \theta_t + \varepsilon_{i,t} \quad (7)$$

$$(Y_{i,t} | EMPL_{i,2013} = 0) = \gamma' EMPL_{i,t} + \delta' X_{i,t} + \zeta' V_{i,t} + \theta_t + \varepsilon_{i,t} \quad (8)$$

in which  $Y_{i,t}$  is an indicator of welfare for household  $i$  at time  $t$ ,  $EMPL_{i,t}$  is a vector of employment variables,  $X_{i,t}$  a set of time-variant observable household characteristics,  $V_{i,t}$  a vector of village characteristics,  $\theta_t$  a time-fixed effect capturing aggregate trends and shocks, and  $\varepsilon_{i,t}$  the error term capturing time-variant unobserved effects. The vector  $X_{i,t}$  includes the age, gender, civil state and level of education of the household head, the number of dependents and workers (18 to 65 years old) in the household, and the share of literate workers in the household to control for differences in human capital, and total landholdings and the number of tropical livestock units (and its square) to control for productive assets. The vector  $V_{i,t}$  includes the distance to a concrete road and a dummy for proximity to an agribusiness company (closer than 3km, a feasible walking distance).

Our main interest is in the coefficients  $\gamma$  and  $\gamma'$  measuring the effect of wage employment on household welfare. We estimate an unconditional model (equation 7) and a model conditional on not having wage employment in 2013 (equation 8). While the coefficient  $\gamma$  in the former model measures the combined effect of entry into or exit from wage employment, the coefficient  $\gamma'$  in the latter measures the pure effect of entry into wage employment. We use three different specifications of the vector  $EMPL_{i,t}$  with variables defined in section 3.2 and table A1. In a first specification we include wage employment in general ( $EMPL$ ), in a second specification agricultural and non-agricultural wage employment ( $AGR\_EMPL$  and  $NONAGR\_EMPL$ ), and in a third specification casual and year-round wage employment ( $CASUAL\_EMPL$  and  $YEAR\_EMPL$ ). For the last two specifications we only estimate the conditional model in equation 8. We use four different specifications of the outcome indicator  $Y_{i,t}$ , including income ( $I_{per\ capita\ i,t}$ ), poverty ( $P_{i,t}$ ), variance of income ( $Var_{i,t}$ ) and vulnerability ( $V_{i,t}$ ) – as defined in section 3.3. For the latter two welfare indicators, the vectors of household and village control variables  $X_{i,t}$  and  $V_{i,t}$  are not included as the same variables were used to estimate the indicators.

The main strength of fixed effects regression is that time-constant unobserved heterogeneity is cancelled out. Yet, this implies that households employed in the two periods cannot be distinguished from control households not employed in any of the two periods. In the conditional model (equation 8) these households are removed to estimate the pure effect of entry into (a specific type of) employment. The fixed effects regressions estimate the welfare effects of entry into (and exit from) employment in the short run while welfare effects of remaining in employment for a longer period of time cannot be derived from these models. Because we hypothesize that the welfare effects of employment vary with the length of employment, we use a second technique.

Second, we more explicitly estimate the impact of short- and long-term employment using a differencing technique as in equation 9.

$$(Y_{i,2016} - Y_{i,2013}) = \kappa TRANS_{EMPL} + \lambda(X_{i,2016} - X_{i,2013}) + \mu(V_{i,2016} - V_{i,2013}) + \varepsilon_i \quad (9)$$

We now specifically include the intertemporal change in welfare indicators as dependent variable ( $Y_{i,2016} - Y_{i,2013}$ ). We use the same four welfare indicators (income, poverty, variance of income and vulnerability) and two additional indicators, wage income (i.e. income derived from agricultural and non-agricultural wage employment) and self-employment income (i.e. income derived from cropping, livestock and non-farm businesses), in order to better understand the channels of effects. For the outcome variables income, poverty, wage income and self-employment income we control for intertemporal changes in household ( $X_{i,2016} - X_{i,2013}$ ) and village characteristics ( $V_{i,2016} - V_{i,2013}$ ) but we do not include these for the outcome variables variance of income and vulnerability. *TRANS\_EMPL* is a categorical variable factored out in the model, classifying households depending on their employment transition over the panel period as defined in section 3.2 and table A1.

## 4 Results

### 4.1.1 Characteristics of employment

Overall, we find that the share of households with wage employment increases over time, from 46% in 2013 to 66% in 2016 (table 1), indicating a growing importance of wage employment in the research area. In addition, we find substantial employment dynamics with 33% of households in upward labor mobility – i.e. moving up from no employment to either casual or year-round employment, or moving up from casual to year-round employment – and 13% of household in downward labor mobility – i.e. either moving out of employment or moving down from year-round to casual employment.

*Table 1: Transition matrix of households switching wage employment categories between 2013 and 2016.*

2013 \ 2016	Without employment	With casual employment	With year-round employment	Total
Without employment	127 (27.55)	60 (13.02)	62 (13.45)	249 (54.01)
With casual employment	15 (3.25)	43 (9.33)	31 (6.72)	89 (19.31)
With year-round employment	15 (3.25)	28 (6.07)	80 (17.35)	123 (26.68)
Total	157 (34.06)	131 (28.42)	173 (37.53)	461 (100)

Frequencies are reported between brackets.

We summarize the characteristics of employment at the individual worker level in table 2. The majority of wage employees in the sample are working on a casual basis. In addition, we find that around 85% of casual workers are employed in the agricultural sector, while for year-round workers this is 45% and 55% for different years. Casual workers have on average less experience than year-round workers, and work fewer days a year in fewer months. We find, in line with the literature (Matsumoto et al., 2006), that real wages in the agricultural sector are low, especially so for casual workers who receive on average less than 2,500 FCFA ( $\approx$  €3.8) for an 8 hour working day. Still, they are above the national minimum agricultural wage of 1,440 FCFA for an 8 hour working day. Wages in the non-agricultural sector are significantly and substantially higher than in the agricultural sector. The wage inequality between year-round and casual workers is, in absolute terms, larger in the non-agricultural sector than in the agricultural sector. In addition, standard deviations for wages are large in general and relatively larger for non-agricultural wages, pointing to substantial wage differences, especially in the non-agricultural sector. We find no changes in real wages over time.



Table 2: Employment characteristics of individual casual and year-round workers in 2013 and 2016

	2013		2016	
	Casual workers	Year-round workers	Casual workers	Year-round workers
Number of workers	276	191	505	312
Share of workers in agricultural sector (%)	85.51	54.45***	83.96	44.55***, ii
Years of experience	5.57 (3.66)	8.79*** (5.53)	5.92 (5.25)	8.08*** (5.27)
Working days per year	162.82 (81.45)	239.13*** (81.37)	164.05 (82.23)	240.79*** (77.22)
Working months per year	6.96 (2.98)	10.08*** (2.38)	7.03 (2.79)	9.55***, ii (2.43)
Daily wage agricultural sector (FCFA)	2,240 (1,755)	3,484*** (2,535)	2,423.06 (1,430.26)	3,748*** (2,121)
Daily wage non-agricultural sector (FCFA)	3,405 <sup>c</sup> (3,690)	6,353***, <sup>c</sup> (7,438)	3,218.52 <sup>c</sup> (3,418)	5,362***, <sup>c</sup> (6,039)

Significant differences between 2013 and 2016 are indicated with <sup>i</sup>  $p < 0.1$ , <sup>ii</sup>  $p < 0.05$  or <sup>iii</sup>  $p < 0.01$ . Significant differences between casual and year-round work are indicated with \*  $p < 0.1$ , \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ . Significant differences between agricultural and non-agricultural wage employment are indicated with <sup>a</sup>  $p < 0.1$ , <sup>b</sup>  $p < 0.05$  or <sup>c</sup>  $p < 0.01$ . We used two-sided t-tests. Standard deviations are reported between parentheses.

#### 4.1.2 Household characteristics and welfare indicators

We compare the characteristics of households with and without wage employment, including a distinction between different types of employment (agricultural, non-agricultural, casual, or year-round), both for 2013 and 2016 in table 3. We find that households with wage employment (any type of wage employment) are larger and better educated than households without employment. There are no differences in land and livestock holdings between households with and without employment, apart from households with agricultural or casual wage employment having significantly smaller landholdings in 2013. Households with agricultural, casual or year-round wage employment are more likely to be located close to an agribusiness company.

With respect to the welfare indicators (table 4), we find that households without wage employment are more likely to be poor and vulnerable than households with wage employment. In addition, households with non-agricultural and year-round employment have a higher per capita income than households without wage employment. Households with wage employment derive significantly less income from self-employment activities, especially so in 2013. Finally, households with agricultural and casual wage employment have a lower (wage) income, and are more likely to be poor and vulnerable than respectively households with non-agricultural and year-round employment. These differences are robust over time.

Table 3: Comparison of household characteristics between households with and without (different types of) wage employment

	2013					2016				
	Without employment	Agricultural employment	Non-agricultural employment	Casual employment	Year-round employment	Without employment	Agricultural employment	Non-agricultural employment	Casual employment	Year-round employment
N	249	161	83	89	123	157	220	149	131	173
Age household head	55.39 (13.7)	58.55 (13.69)	56.68 (14.97)	57.10 (12.95)	58.31* (14.81)	55.32 (13.48)	60.02 (13.65)	59.65 (14.22)	57.50 (13.61)	60.45 (14.42)
Female household head <sup>A</sup>	0.14 (0.35)	0.08** (0.26)	0.13 (0.34)	0.07* (0.25)	0.11 (0.32)	0.17 (0.38)	0.16 (0.36)	0.13 (0.34)	0.16 (0.37)	0.13 (0.33)
Married household head <sup>A</sup>	0.90 (0.30)	0.91 (0.29)	0.90 (0.30)	0.92 (0.27)	0.91 (0.29)	0.90 (0.30)	0.91 (0.28)	0.90 (0.30)	0.90 (0.30)	0.93 (0.26)
Elementary education household head <sup>A</sup>	0.10 (0.30)	0.24*** (0.43)	0.30*** (0.46)	0.24*** (0.43)	0.25*** (0.44)	0.21 (0.41)	0.18 (0.38)	0.20 (0.40)	0.18 (0.39)	0.19 (0.39)
Secondary education household head <sup>A</sup>	0.03 (0.17)	0.11*** (0.31)	0.15*** (0.35)	0.05 (0.21)	0.17***, c (0.38)	0.06 (0.23)	0.15*** (0.35)	0.16*** (0.37)	0.11 (0.31)	0.20***, b (0.40)
Number of working age members	4.06 (2.47)	5.68*** (3.09)	6.05*** (3.08)	5.30*** (2.91)	5.92*** (3.03)	4.14 (2.21)	6.17*** (3.42)	6.36***, a (3.57)	5.37*** (3.06)	6.52***, c (3.56)
Number of dependent members	4.87 (2.64)	5.79*** (3.68)	6.30*** (3.85)	5.73** (3.91)	6.05*** (3.56)	5.05 (2.46)	5.81** (3.69)	5.99** (4.26)	5.24 (2.99)	6.20***, b (4.22)
Share literate working age members	0.25 (0.31)	0.466*** (0.35)	0.54***, a (0.33)	0.45*** (0.36)	0.51*** (0.33)	0.34 (0.31)	0.47*** (0.33)	0.44*** (0.33)	0.39 (0.34)	0.50***, c (0.33)
Total landholdings (ha)	3.50 (8.97)	1.55*** (2.93)	3.10 <sup>c</sup> (6.66)	1.63* (3.12)	2.17 (5.16)	1.82 (2.69)	1.81 (2.99)	2.19 (3.70)	2.18 (3.49)	1.75 (2.85)
Tropical livestock units	11.10 (45.12)	4.92 (13.92)	4.04 (10.25)	5.44 (11.53)	4.45 (14.43)	3.80 (9.26)	3.12 (7.06)	2.40 (4.86)	3.62 (6.97)	2.46 (6.11)
Distance to concrete road	2.81 (3.35)	2.11 (3.39)	1.39 (2.14)	2.73 (3.82)	1.41 (2.42)	2.12 (2.46)	1.70 (2.24)	1.40 (2.09)	1.89 (2.39)	1.38 (2.00)
Horticultural export company close <sup>A</sup>	0.24 (0.43)	0.76*** (0.43)	0.31 <sup>c</sup> (0.47)	0.73*** (0.45)	0.54***, c (0.50)	0.31 (0.46)	0.78*** (0.42)	0.38 <sup>c</sup> (0.49)	0.67*** (0.47)	0.55***, b (0.50)

We compare households with agricultural, non-agricultural, casual or year-round employment with households without employment using two-sided t-tests and indicating significant differences with \*  $p < 0.1$ . \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ . We compare respectively agricultural vs non-agricultural wage employment, and casual vs year-round employment using two-sided t-test and indicating significant differences with <sup>a</sup>  $p < 0.1$ , <sup>b</sup>  $p < 0.05$  or <sup>c</sup>  $p < 0.01$ . Standard errors are reported between parentheses. <sup>A</sup> Dummies.

Table 4: Comparison of income, income variability, poverty and vulnerability between household with and without (different types of) wage employment

	2013					2016				
	Without employment	Agricultural employment	Non-agricultural employment	Casual employment	Year-round employment	Without employment	Agricultural employment	Non-agricultural employment	Casual employment	Year-round employment
N	249	161	83	89	123	157	220	149	131	173
Per capita income (1000 FCFA) <sup>+</sup>	442.28 (516.40)	504.52 (467.23)	668.07***, c (611.42)	429.67 (531.58)	596.23***, c (392.05)	353.92 (488.62)	532.47*** (440.66)	605.47***, b (478.26)	459.37* (502.03)	608.64***, c (427.86)
Poverty <sup>A</sup>	0.45 (0.50)	0.29*** (0.45)	0.18***, b (0.39)	0.38 (0.49)	0.16***, c (0.37)	0.52 (0.50)	0.26*** (0.44)	0.17***, c (0.38)	0.39** (0.49)	0.15***, c (0.35)
Variance of income	3.73 (3.19)	2.95** (2.93)	3.10 (3.77)	3.17 (3.00)	3.14 (3.55)	5.61 (5.92)	4.57* (5.14)	2.98***, c (4.10)	4.55 (5.27)	3.72*** (4.79)
Vulnerability	0.47 (0.21)	0.38*** (0.22)	0.35***, b (0.21)	0.43 (0.21)	0.35***, c (0.20)	0.53 (0.21)	0.39*** (0.20)	0.34***, c (0.21)	0.41*** (0.19)	0.36***, b (0.22)
Income from wage employment (1000 FCFA) <sup>+</sup>	/	245.34*** (258.70)	373.96***, c (331.43)	175.20*** (280.05)	331.37***, c (234.14)	/	257.54*** (250.06)	364.68***, c (337.78)	172.77*** (237.19)	357.14***, c (283.11)
Income from self-employment (1000 FCFA) <sup>+</sup>	347.75 (496.50)	198.00*** (362.28)	223.56** (460.67)	207.66** (409.20)	185.20*** (280.22)	321.40 (487.52)	252.11 (359.56)	207.51** (292.31)	266.10 (394.21)	219.21** (314.08)

We compare households with agricultural, non-agricultural, casual or year-round employment with households without employment using two-sided t-tests and indicating significant differences with \* p < 0.1. \*\* p < 0.05 or \*\*\* p < 0.01. We compare respectively agricultural vs non-agricultural wage employment, and casual vs year-round employment using two-sided t-test and indicating significant differences with <sup>a</sup> p < 0.1. <sup>b</sup> p < 0.05 or <sup>c</sup> p < 0.01. Standard errors are reported between parentheses. <sup>+</sup> Per adult equivalent. <sup>A</sup> Dummies.

### 4.1.3 Welfare effects of wage employment

We report a summary of the estimated effects of wage employment in general, of agricultural and non-agricultural wage employment, and of casual and year-round wage employment on the different welfare indicators in table 5. The full results of these regressions are reported in tables A3, A4, A5 and A6 in appendix. The results of the FGLS regressions on income are reported in table A2.

*Table 5: Impact of (different types of) wage employment on welfare indicators, unconditional and conditional on not having wage employment in 2013, estimated from fixed effects regressions.*

	N	Income <sup>+</sup>	Poverty	Variance income	Vulnerability
Employment (unconditional)	922	0.72 ** (0.30)	-0.24 *** (0.06)	-0.53 (0.52)	-0.09 *** (0.02)
Employment (conditional)	498	1.40 *** (0.52)	-0.34 *** (0.09)	-1.78 ** (0.82)	-0.16 *** (0.04)
Agricultural wage employment (conditional)	498	1.61 *** (0.59)	-0.35 *** (0.10)	-0.08 (0.90)	-0.12 *** (0.04)
Non-agricultural wage employment (conditional)		0.50 (0.57)	-0.19 * (0.10)	-2.14 ** (0.90)	-0.13 *** (0.04)
Casual wage employment (conditional)	498	1.23 * (0.63)	-0.33 *** (0.11)	-2.10 ** (1.01)	-0.16 *** (0.04)
Year-round wage employment (conditional)		1.57 ** (0.64)	-0.35 *** (0.11)	-1.47 (1.00)	-0.16 *** (0.04)

Effects that are significantly different from 0 are indicated with \*  $p < 0.1$ , \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ . Full regression results are reported in tables A3, A4, A5 and A6 in appendix. Standard errors are reported between parentheses. <sup>+</sup> log of per adult equivalent household income.

The results from the unconditional regression reveal that the participation of household members in wage employment increases household income, and reduces the likelihood to be poor as well as the vulnerability to poverty. The point estimates indicate strong effects, with employment increasing household income with 70% and reducing poverty and vulnerability with respectively 24% points and 9%. When we consider entry into wage employment in the conditional regression, the coefficients of Income, Poverty and Vulnerability remain significant and are considerably larger while the negative coefficient on Variance of income becomes significant. This implies that the estimated welfare effects of employment are driven more by welfare-enhancing effects of entering employment than by a welfare-reducing effect of exiting employment

We find that entry into agricultural employment increases household income and reduces poverty significantly. Effects are large: households entering agricultural employment experience an income increase of 161% and a poverty reduction of 35% points. Remarkably, non-agricultural wage employment does not have a significant effect on household income. Both entry into agricultural and

non-agricultural employment decrease vulnerability, with effects similar in magnitude (12% and 13%). However, as vulnerability is a combination of two components – the expected level of income and the variance of income – the results imply that the underlying mechanism of vulnerability reduction is not the same. While agricultural employment reduces vulnerability through a positive income effect, non-agricultural employment reduces vulnerability by decreasing the variance of income. Casual and year-round employment both increase income, and decrease poverty and vulnerability. Effects are similar and large: casual employment increases income with 123% and decreases poverty with 33% points and vulnerability with 16% while year-round employment increases income with 125% and decreases poverty with 35% points and vulnerability with 16%. Only casual employment decreases the variance of income significantly.

We report a summary of the estimated effects of short- and long-term casual and year-round wage employment in table 6. The full results of these regressions are reported in tables A7 in appendix.

*Table 6: Impact of short- and long-term casual and year-round wage employment on different welfare indicators, estimated from first-differencing models*

	Income <sup>+</sup>	Poverty	Variance income	Vulnerability	Wage income <sup>+</sup>	Self-employment income <sup>+</sup>
Entry into casual employment	0.86 (0.52)	-0.30 *** (0.10)	-2.10 ** (0.94)	-0.16 *** (0.04)	11.38 *** (0.15)	-0.68 (0.91)
Always casual employment	1.20 ** (0.59)	-0.09 (0.11)	-0.85 (1.05)	-0.14 *** (0.05)	0.30 * (0.17)	2.47 ** (1.01)
Transition casual to year-round employment	1.30 * (0.67)	-0.28 ** (0.13)	0.12 (1.20)	-0.20 *** (0.05)	0.77 *** (0.19)	0.87 (1.16)
Entry into year-round employment	1.18 ** (0.53)	-0.29 *** (0.10)	-1.47 (0.92)	-0.16 *** (0.04)	12.43 *** (0.15)	-2.26 ** (0.91)
Always year-round employment	0.78 (0.48)	-0.16 * (0.09)	-2.51 *** (0.85)	-0.10 *** (0.04)	0.03 (0.14)	0.50 (0.83)

Effects that are significantly different from 0 are indicated with \*  $p < 0.1$ . \*\*  $p < 0.05$  or \*\*\*  $p < 0.01$ . Full regression results are reported in table A7 in appendix. Standard errors are reported between parentheses. <sup>+</sup> log per adult equivalent. N = 461 for all specifications.

We find that effects on welfare vary progressively when the length of employment increases. First, we observe that short-term casual employment – the category “entry into casual employment” – does not add significantly to the household income. However, it reduces poverty with 30% points and vulnerability with 16%. The reduction in vulnerability is mainly driven by a significant reduction in the variance of income. Second, households who work on a casual basis for a longer period of time – the category “always casual employment” – experience a large decrease in vulnerability of 14%. This vulnerability decrease is now driven by a significantly positive and large effect on income – per capita income increases with 120% – rather than a reduction in the variance of income. Third, the transition from casual to year-round employment increases income with 130% and reduces poverty with 30%

points. Fourth, entry into year-round employment increases income with 119%, and reduces poverty with 29% points and vulnerability with 16%. Continuous year-round employment reduces poverty with 16% points and vulnerability with 10%. The latter effect is driven by a significant reduction in the variance of income and not by an income effect.

The welfare effects related to transitions in wage employment do not only stem from direct effects on the income earned from wages but also through indirect effects on other income sources. Columns 5 and 6 of table 6 reveal that entry into (casual or year-round) employment leads to very sharp increases in the income from wage employment. Yet, long term casual employment does not only result in an increase in wage income but also in an increase in income from self-employment while entry into year-round employment is found to significantly reduce income from self-employment.

## 5 Discussion

Four main findings emerge from the results. First, we find that in general, rural wage employment increases household welfare. Entry into wage employment is found to increase per capita income with 140%, to smoothen income significantly, to reduce the likelihood to be poor with 34% points and the likelihood to become or remain poor in the near future with 16%. Our results point to a quite large welfare impact of rural wage employment, and confirm previous findings on an income-increasing, income-smoothing and poverty-reducing effect of wage employment (Ito & Kurosaki, 2009; Kijima et al., 2006; Maertens, Colen, & Swinnen, 2011; Van den Broeck et al., 2017).

Second, we find that casual and agricultural wage employment – in the literature often described as an inferior and precarious type of employment – improves household welfare. Despite substantially lower wages for casual work and for employment in the agricultural sector, we find substantial income-enhancing effects of entry into such employment. We thereby contest previous findings that low-return casual and agricultural wage employment does not significantly add to household income (Matsumoto et al., 2006). In addition, we find a strong poverty-reducing effect (about 33% points) of entry into casual or agricultural wage employment, and a quite substantial upward employment mobility with about one third of households moving from casual to year-round employment in the three-year period under study. This refutes the idea that casual employment can trap people into poverty. Yet, we need to note that in our study region casual workers work on average almost 7 months a year, which is quite long and implies that casual employment is unsecure but not necessarily unstable. Effects could differ where the duration of casual employment is shorter.

Third, we find that the welfare effects of casual employment vary with the length of employment. Households entering casual employment experience a reduction in poverty and vulnerability, which stems from a direct increase in wage income that does not result in a major overall income boost, and a reduction in income variability. Households remaining in casual employment experience a more substantial increase in per capita income, which stems from a further increase in wage income and an indirect increase in self-employment income. Casual employment seems to have in the first place a direct income-smoothing effect, followed by an indirect income-enhancing effect. The direct income-smoothing effect reduces the vulnerability of rural households and helps them to face shocks, as confirmed for other developing countries by for example Kijima et al. (2006), Ito & Kurosaki (2009) or Cunguara et al. (2011). Faced with lower risk and reduced liquidity constraints, households' ability to make productive investments increases, resulting in increased investments in agricultural or non-agricultural businesses and an indirect income-enhancing effect – also knowledge spill-over effects might play a role. Such investment spill-over effects of rural employment have been documented for

other regions by Maertens (2009), Oseni & Winters (2009), Smale et al. (2016), Stampini & Davis (2009). Besides, our results refute the idea of a trade-off between an income-smoothing and an income-enhancing effect of rural employment (Alobo Loison, 2015). We find that casual employment both smooths and boosts income but not instantly.

Fourth, our results indicate that year-round employment – whether in the agricultural or non-agricultural sector – leads to higher wages, larger and smoother incomes and lower poverty rates than casual employment. Entry into a stable job increases income directly through wages but does not lead to the type of indirect effects observed for casual employment. In the longer run, year-round employment leads to specialization and high and stable incomes. Despite the positive welfare effects of casual employment, year-round employment entails better jobs. Yet, given the observed substantial upward employment mobility, casual employment might be an important steppingstone to accumulate skills and capital to enter high-return and stable employment – as documented by Bezu & Barrett (2012) in Ethiopia.

Our results entail important implications. Before turning to these we need to acknowledge that our results are derived from a particular research area where the income share households derive from agricultural wage employment is high in comparison to other African countries (Davis, Di Giuseppe, & Zezza, 2014). The welfare implications of rural wage employment may differ for other regions. Nevertheless, our results imply that the development of a rural labor market is important for rural development and that rural labor market issues deserve more attention from policy-makers and researchers. In addition, we document that agriculture can be an important source of rural wage employment. Agriculture remains an important sector as an engine of growth and poverty reduction in rural areas, not only through smallholder farming but also through the creation of jobs that are accessible for the poor and improve their welfare. Agriculture is often neglected as a source of employment and growth because of the casual or seasonal character of agricultural employment. Yet, casual work can bring about important welfare effects. We find that in our study region, casual work first smooths income, and then boosts income through indirect investment effects. As such, long-term casual employment could substitute for microfinance programs, which can be inaccessible and even harmful for the poorest (Van Rooyen et al., 2012; Adjognon et al., 2017). Agricultural credit might have a stronger impact on rural development if allocated to agribusinesses and larger farms, and reducing the liquidity and investment constraints of rural households through wage employment instead of through micro-credit. Finally, our results call for a revision of the definition of the rural non-farm economy (RNFE). All too often agricultural wage employment is neglected in RNFE studies. Our results imply that agricultural wage employment can have equally important welfare effects as have been documented for non-farm businesses and non-agricultural wage employment. Agricultural



wage employment is a full component of the RNFE, and should be more comprehensively included in data collection efforts and studies on the access to and the impact of RNFE activities.

## 6 Conclusion

In this paper we analyze the importance of wage employment for rural development using household-level panel data from two survey rounds conducted in 2013 and 2016 in Senegal. The study region contains a diverse and dynamic rural labor market, including agricultural and non-agricultural employment, and casual and year-round employment. We use fixed effects regressions and differencing techniques to estimate the effect of different types of wage employment on per capita income, poverty, income variability, and vulnerability. The results point to substantial positive welfare effects: we find that entry into wage employment increases income with 140%, smoothens income significantly, reduces the likelihood to be poor with 34% points and the likelihood to become or remain poor with 16%. Despite substantially lower wages for casual and agricultural employment, we find substantial income-enhancing and poverty-reducing effects of such employment. Casual employment is found to at first smooth incomes and to then boost incomes either through upward employment mobility to higher-return jobs or through relaxing investment constraints and increased income from self-employment.

This paper shows that jobs are important for rural development as they both smooth and boost rural incomes; that the agricultural sector can be an important source of jobs; and that casual jobs can be an important source of upward income mobility. Our results corroborate claims on the importance of the rural non-farm economy but refute the idea of casual or agricultural employment not contributing to household welfare and rural development. Agricultural wage employment is a full component of the rural non-farm economy and deserves more research attention.

## 7 References

- Adjognon, S. G., Liverpool-Tasie, L. S. O., de la Fuente, A., & Benfic, R. (2017). *Rural Non-Farm Employment and Household Welfare Evidence from Malawi* (World Bank Working Paper Series No. 8096).
- Adjognon, S. G., Liverpool-Tasie, L. S. O., & Reardon, T. (2017). Agricultural input credit in Sub-Saharan Africa: Telling myth from facts. *Food Policy*, *67*, 93–105. <https://doi.org/10.1016/j.foodpol.2016.09.014>
- Alobo Loison, S. (2015). Rural Livelihood Diversification in Sub-Saharan Africa: A Literature Review. *Journal of Development Studies*, *51*(9), 1125–1138. <https://doi.org/10.1080/00220388.2015.1046445>
- Babatunde, R. O., & Qaim, M. (2009). The role of off-farm income diversification in rural Nigeria: Driving forces and household access. *Quarterly Journal of International Agriculture*, *48*(4), 305–320.
- Barrett, C. B., Carter, M. R., & Timmer, C. P. (2010). A Century-Long Perspective On Agricultural Development. *American Journal of Agricultural Economics*, *92*(2), 447–468. <https://doi.org/10.1093/ajae/aaq005>
- Barrett, C. B., Christiaensen, L., Sheahan, M., Shimeles, A., & Dyson, C. H. (2017). On the Structural Transformation of Rural Africa. *Journal of African Economies*, *26*(1), 11–35. <https://doi.org/10.1093/jae/ejx009>
- Barrett, C. B., Reardon, T., & Webb, P. (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy*, *26*, 315–331. [https://doi.org/10.1016/S0306-9192\(01\)00014-8](https://doi.org/10.1016/S0306-9192(01)00014-8)
- Barrientos, S., Gereffi, G., Posthuma, A., Mayer, F., & Pickles, J. (2011). Decent Work in Global Production Networks Framing the policy debate. *International Labour Review*, *150*, 3–4. <https://doi.org/10.1111/j.1564-913X.2011.00118.x>
- Beegle, K., Christiaensen, L., Dabalén, A., & Gaddis, I. (2016). *Poverty in a Rising Africa* (Africa Poverty Report). Washington, DC: World Bank. <https://doi.org/10.1596/978-1-4648-0723-7>
- Bezu, S., & Barrett, C. B. (2012). Employment Dynamics in the Rural Nonfarm Sector in Ethiopia: Do the Poor Have Time on Their Side? *Journal of Development Studies*, *48*(9), 1223–1240. <https://doi.org/10.1080/00220388.2012.671476>
- Bezu, S., Barrett, C. B., & Holden, S. T. (2012). Does the Nonfarm Economy Offer Pathways for Upward Mobility? Evidence from a Panel Data Study in Ethiopia. *World Development*, *40*(8), 1634–1646. <https://doi.org/10.1016/j.worlddev.2012.04.019>
- Bogale, A. (2012). Vulnerability of smallholder rural households to food insecurity in Eastern Ethiopia. *Food Security*, *4*, 581–591. <https://doi.org/10.1007/s12571-012-0208-x>
- Cahyadi, E. R., & Waibel, H. (2015). Contract Farming and Vulnerability to Poverty among Oil Palm Smallholders in Indonesia. *The Journal of Development Studies*, *388*(December), 1–15. <https://doi.org/10.1080/00220388.2015.1098627>
- Celidoni, M. (2013). Vulnerability to poverty: an empirical comparison of alternative measures. *Applied Economics*, *45*, 1493–1506. <https://doi.org/10.1080/00036846.2011.624271>
- Celidoni, M. (2015). Decomposing vulnerability to poverty. *Review of Income and Wealth*, *61*(1), 59–74. <https://doi.org/10.1111/roiw.12074>
- Chaudhuri, S., Jalan, J., & Suryahadi, A. (2002). *Assessing Household Vulnerability to Poverty from*

*Cross-sectional Data: A Methodology and Estimates from Indonesia* (Department of Economics Discussion Paper Series No. 0102–52).

- Corral, L., & Reardon, T. (2001). Rural Nonfarm Incomes in Nicaragua. *World Development*, 29(3), 427–442.
- Cunguara, B., Langyintuo, A., & Darnhofer, I. (2011). The role of nonfarm income in coping with the effects of drought in southern Mozambique. *Agricultural Economics*, 42(6), 701–713. <https://doi.org/10.1111/j.1574-0862.2011.00542.x>
- Davis, B., Di Giuseppe, S., & Zezza, A. (2014). *Income diversification patterns in rural Sub-Saharan Africa: reassessing the evidence* (World Bank Working Paper Series No. 7108). *World Bank Working Paper Series* (Vol. 7108).
- Davis, B., Winters, P., Carletto, G., Covarrubias, K., Quiñones, E. J., Zezza, A., ... DiGiuseppe, S. (2010). A Cross-Country Comparison of Rural Income Generating Activities. *World Development*, 38(1), 48–63. <https://doi.org/10.1016/j.worlddev.2009.01.003>
- Dutta, I., Foster, J., & Mishra, A. (2011). On measuring vulnerability to poverty. *Social Choice and Welfare*, 37(4), 743–761. <https://doi.org/10.1007/s00355-011-0570-1>
- Fahy Bryceson, D. (2002). Multiplex livelihoods in rural Africa: recasting the terms and conditions of gainful employment. *The Journal of Modern African Studies*, 40(1), 1–28.
- Fink, G., Kelsey, B., Masiye, J. F., Jack, B. K., & Masiye, F. (2014). *Seasonal credit constraints and agricultural labor supply: Evidence from Zambia* (NBER Working Paper Series No. 20218).
- Gouvernement Sénégalais. (2014). *Evaluation quantitative du DSRP-II - Dynamique de la pauvreté monétaire*.
- Günther, I., & Harttgen, K. (2009). Estimating Households Vulnerability to Idiosyncratic and Covariate Shocks: A Novel Method Applied in Madagascar. *World Development*, 37(7), 1222–1234. <https://doi.org/10.1016/j.worlddev.2008.11.006>
- Haggblade, S., Hazell, P. B. R., & Reardon, T. (2007). *Transforming the rural nonfarm economy - Opportunities and threats in the developing world*. (S. Haggblade, P. B. R. Hazell, & T. Reardon, Eds.). Washington, D.C.: The International Food Policy Research Institute. <https://doi.org/10.1080/00220380802160002>
- Haggblade, S., Hazell, P., & Reardon, T. (2010). The Rural Non-farm Economy: Prospects for Growth and Poverty Reduction. *World Development*, 38(10), 1429–1441. <https://doi.org/10.1016/j.worlddev.2009.06.008>
- Herrmann, R., & Grote, U. (2015). Large-scale agro-industrial investments and rural poverty: Evidence from sugarcane in Malawi. *Journal of African Economies*, 24(5), 645–676. <https://doi.org/10.1093/jae/ejv015>
- Hoddinott, J., & Quisumbing, A. (2010). Methods for Microeconomic Risk and Vulnerability Assessment. In *Risk, Shocks, and Human Development* (pp. 62–100). London: Palgrave Macmillan UK. [https://doi.org/10.1057/9780230274129\\_4](https://doi.org/10.1057/9780230274129_4)
- Hohberg, M., Landau, K., Kneib, T., Klasen, S., & Zucchini, W. (2018). Vulnerability to poverty revisited: Flexible modeling and better predictive performance. *The Journal of Economic Inequality*. <https://doi.org/10.1007/s10888-017-9374-6>
- Hoogeveen, J. G. (2005). Measuring Welfare for Small but Vulnerable Groups: Poverty and Disability in Uganda. *Journal of African Economies*, 14(4), 603–631. <https://doi.org/10.1093/jae/eji020>
- Imai, K. S. (2011). Poverty, undernutrition and vulnerability in rural India: role of rural public works

- and food for work programmes. *International Review of Applied Economics*, 25(6), 669–691. <https://doi.org/10.1080/02692171.2011.557052>
- Imai, K. S., Gaiha, R., & Kang, W. (2011). Vulnerability and poverty dynamics in Vietnam. *Applied Economics*, 43(25), 3603–3618. <https://doi.org/10.1080/00036841003670754>
- Imai, K. S., Gaiha, R., & Thapa, G. (2015). Does non-farm sector employment reduce rural poverty and vulnerability? Evidence from Vietnam and India. *Journal of Asian Economics*, 36, 47–61. <https://doi.org/10.1016/j.asieco.2015.01.001>
- Ito, T., & Kurosaki, T. (2009). Weather Risk, Wages in Kind, and the Off-Farm Labor Supply of Agricultural Households in a Developing Country. *American Journal of Agricultural Economics*, 91(3), 697–710.
- Jonasson, E., & Helfand, S. M. (2010). How Important are Locational Characteristics for Rural Non-agricultural Employment? Lessons from Brazil. *World Development*, 38(5), 727–741. <https://doi.org/10.1016/j.worlddev.2009.11.020>
- Kerr, R. B. (2005). Informal Labor and Social Relations in Northern Malawi: The Theoretical Challenges and Implications of Ganyu Labor for Food Security. *Rural Sociology*, 70(2), 167–187. <https://doi.org/10.1526/0036011054776370>
- Kijima, Y., & Lanjouw, P. (2005). Economic Diversification and Poverty in Rural India. *The Indian Journal of Labour Economics*, 48(2).
- Kijima, Y., Matsumoto, T., & Yamano, T. (2006). Nonfarm employment, agricultural shocks, and poverty dynamics: Evidence from rural Uganda. *Agricultural Economics*, 35(SUPPL. 3), 459–467. <https://doi.org/10.1111/j.1574-0862.2006.00191.x>
- Klasen, S., & Waibel, H. (2013). *Vulnerability to poverty: Theory, measurement and determinants with case studies from Thailand and Vietnam*. (S. Klasen & H. Waibel, Eds.) (First edit). London: Palgrave Macmillan.
- Klasen, S., & Waibel, H. (2014). Vulnerability to Poverty in South-East Asia: Drivers, Measurement, Responses, and Policy Issues. *World Development*, 71, 1–3. <https://doi.org/10.1016/j.worlddev.2014.01.007>
- Lanjouw, J. O., & Lanjouw, P. (2001). The rural non-farm sector: issues and evidence from developing countries. *Agricultural Economics*, 26, 1–23.
- Lanjouw, P., & Murgai, R. (2009). Poverty decline, agricultural wages, and nonfarm employment in rural India: 1983-2004. *Agricultural Economics*, 40(2), 243–263. <https://doi.org/10.1111/j.1574-0862.2009.00373.x>
- Lay, J., Mahmoud, T. O., & Michuki M ’mukaria, G. (2008). Few Opportunities, Much Desperation: The Dichotomy of Non-Agricultural Activities and Inequality in Western Kenya. *World Development*, 36(12), 2713–2732. <https://doi.org/10.1016/j.worlddev.2007.12.003>
- Ligon, E., & Schechter, L. (2003). Measuring Vulnerability. *The Economic Journal*, 113(486), 95–102.
- Ligon, E., & Schechter, L. (2004). *Evaluating Different Approaches to Estimating Vulnerability* (Social Protection Discussion Paper Series No. 410). *World Bank Social Protection Discussion Paper Series*.
- Maertens, M. (2009). Horticulture exports, agro-industrialization, and farm-nonfarm linkages with the smallholder farm sector: Evidence from Senegal. *Agricultural Economics*, 40(2), 219–229. <https://doi.org/10.1111/j.1574-0862.2009.00371.x>

- Maertens, M., Colen, L., & Swinnen, J. F. M. (2011). Globalisation and poverty in Senegal: A worst case scenario? *European Review of Agricultural Economics*, 38(1), 31–54. <https://doi.org/10.1093/erae/jbq053>
- Maertens, M., Minten, B., & Swinnen, J. F. M. (2012). Modern Food Supply Chains and Development: Evidence from Horticulture Export Sectors in Sub-Saharan Africa. *Development Policy Review*, 30(4), 473–497.
- Maertens, M., & Swinnen, J. F. M. (2009). Trade, Standards, and Poverty: Evidence from Senegal. *World Development*, 37(1), 161–178. <https://doi.org/10.1016/j.worlddev.2008.04.006>
- Mathenge, M. K., & Tschirley, D. L. (2015). Off-farm labor market decisions and agricultural shocks among rural households in Kenya. *Agricultural Economics*, 46(5), 603–616. <https://doi.org/10.1111/agec.12157>
- Matsumoto, T., Kijima, Y., & Yamano, T. (2006). The role of local nonfarm activities and migration in reducing poverty: Evidence from Ethiopia, Kenya, and Uganda. *Agricultural Economics*, 35(SUPPL. 3), 449–458. <https://doi.org/10.1111/j.1574-0862.2006.00190.x>
- Mccullough, E. B. (2017). Labor productivity and employment gaps in Sub-Saharan Africa. *Food Policy*, 67, 133–152. <https://doi.org/10.1016/j.foodpol.2016.09.013>
- Nelson, V., Martin, A., & Ewert, J. (2007). The Impacts of Codes of Practice on Worker Livelihoods Empirical Evidence from the South African. *Journal of Corporate Citizenship*, 28(October), 61–73.
- Orr, A., Mwale, B., & Saiti-Chitsonga, D. (2009). Exploring Seasonal Poverty Traps: The “Six-Week Window” in Southern Malawi. *The Journal of Development Studies*, 45(2), 227–255. <https://doi.org/10.1080/00220380802265330>
- Oseni, G., & Winters, P. (2009). Rural nonfarm activities and agricultural crop production in Nigeria. *Agricultural Economics*, 40(2), 189–201. <https://doi.org/10.1111/j.1574-0862.2009.00369.x>
- Oya, C. (2013). Rural wage employment in Africa: methodological issues and emerging evidence. *Review of African Political Economy*, 40(136), 251–273. <https://doi.org/10.1080/03056244.2013.794728>
- Povel, F. (2014). Measuring Exposure to Downside Risk with an Application to Thailand and Vietnam. *World Development*, 71, 4–24. <https://doi.org/10.1016/j.worlddev.2013.11.006>
- Pritchett, L., Suryahadi, A., & Sumarto, S. (2000). *Quantifying Vulnerability to Poverty: A Proposed Measure, with Application to Indonesia* (World Bank Working Paper Series No. 2437).
- Reardon, T. (1998). *Rural Non-farm Income in Developing Countries* (FAO Agriculture Series No. 31). Rome.
- Reardon, T., Berdegue, J., & Escobar, G. (2001). Rural Nonfarm Employment and Incomes in Latin America: Overview and Policy Implications. *World Development*, 29(3), 395–409.
- Rose, E. (2001). Ex ante and ex post labor supply response to risk in a low-income area. *Journal of Development Economics*, 64, 371–388.
- Scharf, M. M., & Rahut, D. B. (2014). Nonfarm employment and rural welfare: Evidence from the Himalayas. *American Journal of Agricultural Economics*, 96(4), 1183–1197. <https://doi.org/10.1093/ajae/aau040>
- Schuster, M., & Maertens, M. (2016). Do private standards benefit workers in horticultural export chains in Peru? *Journal of Cleaner Production*, 112, 2392–2406. <https://doi.org/10.1016/j.jclepro.2015.10.038>

- Smale, M., Kusunose, Y., Mathenge, M. K., & Alia, D. (2016). Destination or distraction? Querying the linkage between off-farm work and food crop investments in Kenya. *Journal of African Economies*, 25(3), 388–417. <https://doi.org/10.1093/jae/ejv032>
- Stampini, M., & Davis, B. (2009). Does nonagricultural labor relax farmers' credit constraints? Evidence from longitudinal data for Vietnam. *Agricultural Economics*, 40(2), 177–188. <https://doi.org/10.1111/j.1574-0862.2009.00368.x>
- Takahashi, K., & Otsuka, K. (2009). The increasing importance of nonfarm income and the changing use of labor and capital in rice farming: The case of Central Luzon, 1979-2003. *Agricultural Economics*, 40(2), 231–242. <https://doi.org/10.1111/j.1574-0862.2009.00372.x>
- Tallontire, A., Dolan, C., Smith, S., & Barrientos, S. (2005). Reaching the marginalised? Gender value chains and ethical trade in African horticulture. *Development in Practice*, 15(3 & 4), 559–571.
- United Nations. (2017). *Progress towards the Sustainable Development Goals. Report of the Secretary-General* (Vol. E/2017/66). <https://doi.org/10.1017/S0020818300006640>
- Van den Broeck, G., Swinnen, J., & Maertens, M. (2017). Global value chains, large-scale farming, and poverty: Long-term effects in Senegal. *Food Policy*, 66, 97–107. <https://doi.org/10.1016/j.foodpol.2016.12.003>
- Van Rooyen, C., Stewart, R., & De Wet, T. (2012). The Impact of Microfinance in Sub-Saharan Africa: A Systematic Review of the Evidence. *World Development*, 40(11), 2249–2262. <https://doi.org/10.1016/j.worlddev.2012.03.012>
- Ward, P. S. (2016). Transient Poverty, Poverty Dynamics, and Vulnerability to Poverty: An Empirical Analysis Using a Balanced Panel from Rural China. *World Development*, 78, 541–553. <https://doi.org/10.1016/j.worlddev.2015.10.022>
- Whiteside, M. (2000). *Ganyu labour in Malawi and its implications for livelihood security interventions – An analysis of recent literature and implications for poverty alleviation* (Network Paper No. 99).
- Winters, P., Essam, T., Zezza, A., Davis, B., & Carletto, C. (2010). Patterns of Rural Development: A Cross-Country Comparison using Microeconomic Data. *Journal of Agricultural Economics*, 61(3), 628–651. <https://doi.org/10.1111/j.1477-9552.2010.00265.x>
- World Bank. (2016). *Poverty and Shared Prosperity 2016: Taking on Inequality*. Washington, DC. <https://doi.org/10.1596/978-1-4648-0958-3>
- Zereyesus, Y. A., Embaye, W. T., Tsiboe, F., & Amanor-Boadu, V. (2017). Implications of Non-Farm Work to Vulnerability to Food Poverty-Recent Evidence From Northern Ghana. *World Development*, 91(February 2016), 113–124. <https://doi.org/10.1016/j.worlddev.2016.10.015>

## 8 Appendix

Table A1: Summary of employment classification

Abbreviation	Classification	Dummy equals one when:
<i>EMPL</i>	Wage employed	At least one member is wage employed
<i>AGR_EMPL</i>	Agricultural wage employed	At least one member is wage employed in the agricultural sector
<i>NONAGR_EMPL</i>	Non-agricultural wage employed	At least one member is wage employed in the non-agricultural sector
<i>CASUAL_EMPL</i>	Casual work	All wage employed members have casual work
<i>YEAR_EMPL</i>	Year-round work	At least one wage employed member has year-round work
<i>TRANS_EMPL</i>	0/ Never wage employed	No member is wage employed in 2013 and 2016
	1/ Entry into casual employment	No member is wage employed in 2013, all wage employed members have casual work in 2016
	2/ Always casual employed	All wage employed members have casual work, both in 2013 and 2016
	3/ Transition from casual to year-round employment	All wage employed members have casual work in 2013, at least one wage employed member has year-round work in 2016
	4/ Entry into year-round employment	No member is wage employed in 2013, at least one wage employed member has year-round work in 2016
	5/ Always year-round employed	At least one wage employed member has year-round work, both in 2013 and 2016
	6/ Transition from year-round to casual employment	At least one wage employed member has year-round work in 2013, all wage employed members have casual work in 2016
	7/ Exit from casual employment	All wage employed members have casual work in 2013, no member is wage employed in 2016
	8/ Exit from year-round employment	At least on wage employed member has year-round work in 2013, no member is wage employed in 2016



Table A2: Results of Feasible Generalized Least Squares regressions estimating income for 2013 and 2016.

	2013		2016	
	Income	Variance	Income	Variance
Age household head	0.02 *** (0.01)	-0.08 ** (0.03)	-0.00 (0.01)	0.01 (0.02)
Female household head <sup>A</sup>	-0.26 (0.36)	0.90 (1.89)	-0.47 (0.30)	0.76 (1.09)
Married household head <sup>A</sup>	-0.46 (0.37)	2.22 (1.93)	-0.48 (0.33)	2.20 * (1.19)
Household head finished primary education <sup>A</sup>	0.81 *** (0.21)	-2.14 * (1.15)	0.32 (0.21)	-1.20 (0.92)
Household head finished secondary education <sup>A</sup>	0.82 *** (0.30)	-2.73 * (1.46)	0.52 ** (0.24)	-1.51 (1.02)
Oulof ethnicity <sup>A</sup>	-0.13 (0.33)	2.39 (1.50)	-0.72 ** (0.35)	4.35 ** (1.71)
Peulh ethnicity <sup>A</sup>	-0.34 (0.30)	1.05 (1.28)	-0.13 (0.33)	0.79 (1.24)
Number of working age members	-0.01 (0.03)	0.15 (0.14)	0.03 (0.03)	-0.30 ** (0.14)
Number of dependent members	-0.06 *** (0.02)	-0.12 (0.12)	-0.06 ** (0.03)	0.20 * (0.11)
Share literate working age members	-0.09 (0.24)	-0.81 (1.04)	0.00 (0.29)	2.24 * (1.27)
Total landholdings	0.01 (0.01)	-0.05 (0.06)	0.01 (0.03)	-0.16 (0.14)
Tropical livestock units	0.02 *** (0.01)	-0.03 (0.03)	0.05 * (0.03)	0.13 (0.11)
(Tropical livestock units) <sup>2</sup>	-0.00 ** (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.01 ** (0.00)
Number of income sources	0.31 *** (0.07)	-0.56 (0.36)	0.39 *** (0.08)	-1.25 *** (0.39)
Village dummies	Included	Included	Included	Included
Constant	11.44 *** (0.75)	5.45 (3.82)	11.91 *** (0.76)	2.37 (3.42)
R <sup>2</sup>	0.29	0.09	0.27	0.15
N	461	461	461	461

<sup>A</sup> Dummy variables. Significant effects are indicated with \* p < 0.1, \*\* p < 0.05 or \*\*\* p < 0.01. Standard errors are reported between parentheses.

Table A3: Results of unconditional fixed effects regressions estimating the impact of wage employment in general on income, poverty, variance of income and vulnerability.

	Income	Poverty	Variance income	Vulnerability
Employment <sup>A</sup>	0.72 ** (0.30)	-0.24 *** (0.06)	-0.53 (0.52)	-0.09 *** (0.02)
Age household head	0.03 (0.02)	-0.00 (0.00)		
Female household head <sup>A</sup>	-0.33 (0.78)	-0.17 (0.15)		
Household head married <sup>A</sup>	-1.00 (0.83)	0.15 (0.16)		
Household head finished primary education <sup>A</sup>	0.28 (0.47)	0.01 (0.09)		
Household head finished secondary education <sup>A</sup>	-0.05 (0.67)	0.17 (0.13)		
Number of working age members	-0.06 (0.08)	-0.00 (0.01)		
Number of dependent members	-0.07 (0.06)	0.02 * (0.01)		
Share literate working age members	-0.29 (0.51)	0.06 (0.10)		
Total landholdings	-0.02 (0.02)	0.00 (0.00)		
Tropical livestock units	0.02 * (0.01)	-0.01 ** (0.00)		
(Tropical livestock units) <sup>2</sup>	-0.00 * (0.00)	0.00 ** (0.00)		
Distance to concrete road	0.02 (0.08)	0.02 (0.02)		
Horticultural export company close	0.16 (0.58)	-0.13 (0.11)		
2016 <sup>A</sup>	-0.17 (0.19)	0.04 (0.04)	1.24 *** (0.30)	0.02 (0.01)
Constant	11.86 *** (1.49)	0.53 * (0.29)	3.71 *** (0.31)	0.47 *** (0.01)
R <sup>2</sup> within	0.04	0.08	0.04	0.03
R <sup>2</sup> between	0.04	0.04	0.02	0.09
N	922	922	922	922

<sup>A</sup> Dummy variables. Significant effects are indicated with \* p < 0.1. \*\* p < 0.05 or \*\*\* p < 0.01. Standard errors are reported between parentheses.

Table A4: Results of fixed effects regressions estimating the impact of wage employment in general on income, poverty, variance of income and vulnerability, conditional on not having wage employment in 2013.

	Income	Poverty	Variance income	Vulnerability
Employment <sup>A</sup>	1.40 *** (0.52)	-0.34 *** (0.09)	-1.78 ** (0.82)	-0.16 *** (0.04)
Age household head	0.08 *** (0.03)	-0.01 (0.01)		
Female household head <sup>A</sup>	0.59 (1.43)	-0.08 (0.25)		
Household head married <sup>A</sup>	-1.05 (1.44)	0.29 (0.25)		
Household head finished primary education <sup>A</sup>	0.66 (0.78)	0.13 (0.14)		
Household head finished secondary education <sup>A</sup>	-0.88 (1.32)	0.45 * (0.23)		
Number of working age members	-0.20 (0.15)	0.03 (0.03)		
Number of dependent members	-0.11 (0.10)	0.04 ** (0.02)		
Share literate working age members	-0.49 (0.85)	-0.09 (0.15)		
Total landholdings	-0.03 (0.03)	0.01 (0.00)		
Tropical livestock units	0.02 (0.02)	-0.01 ** (0.00)		
(Tropical livestock units) <sup>2</sup>	-0.00 (0.00)	0.00 * (0.00)		
Distance to concrete road	0.36 *** (0.13)	-0.01 (0.02)		
Horticultural export company close	0.14 (0.78)	-0.12 (0.14)		
2016 <sup>A</sup>	-0.51 (0.39)	0.07 (0.07)	2.26 *** (0.57)	0.09 *** (0.02)
Constant	8.86 *** (2.62)	0.32 (0.45)	3.73 *** (0.29)	0.47 *** (0.01)
R <sup>2</sup> within	0.11	0.15	0.06	0.08
R <sup>2</sup> between	0.01	0.01	0.00	0.01
N	498	498	498	498

<sup>A</sup> Dummy variables. Significant effects are indicated with \* p < 0.1. \*\* p < 0.05 or \*\*\* p < 0.01. Standard errors are reported between parentheses.

Table A5: Results of fixed effects regressions estimating the impact of agricultural and non-agricultural wage employment on income, poverty, variance of income and vulnerability, conditional on not having wage employment in 2013.

	Income	Poverty	Variance income	Vulnerability
Agricultural employment <sup>A</sup>	1.61 *** (0.59)	-0.35 *** (0.10)	-0.08 (0.90)	-0.12 *** (0.04)
Non-agricultural employment <sup>A</sup>	0.50 (0.57)	-0.19 * (0.10)	-2.14 ** (0.90)	-0.13 *** (0.04)
Age household head	0.08 *** (0.03)	-0.01 (0.01)		
Female household head <sup>A</sup>	0.34 (1.43)	-0.03 (0.25)		
Household head married <sup>A</sup>	-1.04 (1.44)	0.29 (0.25)		
Household head finished primary education <sup>A</sup>	0.88 (0.79)	0.09 (0.14)		
Household head finished secondary education <sup>A</sup>	-0.37 (1.34)	0.35 (0.23)		
Number of working age members	-0.19 (0.15)	0.03 (0.03)		
Number of dependent members	-0.11 (0.10)	0.04 ** (0.02)		
Share literate working age members	-0.62 (0.86)	-0.07 (0.15)		
Total landholdings	-0.03 (0.03)	0.01 (0.00)		
Tropical livestock units	0.02 (0.02)	-0.01 ** (0.00)		
(Tropical livestock units) <sup>2</sup>	-0.00 (0.00)	0.00 * (0.00)		
Distance to concrete road	0.36 *** (0.13)	-0.01 (0.02)		
Horticultural export company close	-0.02 (0.79)	-0.09 (0.14)		
2016 <sup>A</sup>	-0.44 (0.38)	0.06 (0.07)	2.02 *** (0.55)	0.08 *** (0.02)
Constant	8.62 *** (2.63)	0.35 (0.46)	3.73 *** (0.29)	0.47 *** (0.01)
R <sup>2</sup> within	0.12	0.15	0.07	0.08
R <sup>2</sup> between	0.01	0.01	0.02	0.01
N	498	498	498	498

<sup>A</sup> Dummy variables. Significant effects are indicated with \* p < 0.1. \*\* p < 0.05 or \*\*\* p < 0.01. Standard errors are reported between parentheses.

Table A6: Results of fixed effects regressions estimating the impact of casual and year-round employment on income, poverty, variance of income and vulnerability, conditional on not having wage employment in 2013.

	Income	Poverty	Variance income	Vulnerability
Casual employment <sup>A</sup>	1.23 *	-0.33 ***	-2.10 **	-0.16 ***
	(0.63)	(0.11)	(1.01)	(0.04)
Year-round employment <sup>A</sup>	1.57 **	-0.35 ***	-1.47	-0.16 ***
	(0.64)	(0.11)	(1.00)	(0.04)
Age household head	0.08 **	-0.01		
	(0.03)	(0.01)		
Female household head <sup>A</sup>	0.65	-0.08		
	(1.44)	(0.25)		
Household head married <sup>A</sup>	-1.09	0.29		
	(1.44)	(0.25)		
Household head finished primary education <sup>A</sup>	0.63	0.13		
	(0.78)	(0.14)		
Household head finished secondary education <sup>A</sup>	-0.89	0.45 *		
	(1.32)	(0.23)		
Number of working age members	-0.21	0.03		
	(0.15)	(0.03)		
Number of dependent members	-0.11	0.04 **		
	(0.10)	(0.02)		
Share literate working age members	-0.45	-0.09		
	(0.86)	(0.15)		
Total landholdings	-0.03	0.01		
	(0.03)	(0.00)		
Tropical livestock units	0.02	-0.01 **		
	(0.02)	(0.00)		
(Tropical livestock units) <sup>2</sup>	-0.00	0.00 *		
	(0.00)	(0.00)		
Distance to concrete road	0.36 ***	-0.01		
	(0.13)	(0.02)		
Horticultural export company close	0.15	-0.12		
	(0.79)	(0.14)		
2016 <sup>A</sup>	-0.50	0.07	2.26 ***	0.09 ***
	(0.39)	(0.07)	(0.57)	(0.02)
Constant	8.95 ***	0.32	3.73 ***	0.47 ***
	(2.63)	(0.46)	(0.29)	(0.01)
R <sup>2</sup> within	0.11	0.15	0.06	0.08
R <sup>2</sup> between	0.01	0.01	0.00	0.01
N	498	498	498	498

<sup>A</sup> Dummy variables. Significant effects are indicated with \* p < 0.1. \*\* p < 0.05 or \*\*\* p < 0.01. Standard errors are reported between parentheses.

Table A7: Results of difference-in-difference estimation on the impact of employment categories on income, poverty, variance of income and vulnerability

	Income	Poverty	Variance income	Vulnerability	Wage income	Self-employment income
Entry into casual	0.86 (0.52)	-0.30 *** (0.10)	-2.10 ** (0.94)	-0.16 *** (0.04)	11.38 *** (0.15)	-0.68 (0.91)
Always casual	1.20 ** (0.59)	-0.09 (0.11)	-0.85 (1.05)	-0.14 *** (0.05)	0.30 * (0.17)	2.47 ** (1.01)
Transition casual to year-round	1.30 * (0.67)	-0.28 ** (0.13)	0.12 (1.20)	-0.20 *** (0.05)	0.77 *** (0.19)	0.87 (1.16)
Exit from casual	-1.25 (0.91)	0.13 (0.18)	0.48 (1.63)	0.04 (0.07)	-11.24 *** (0.26)	1.14 (1.58)
Entry into year-round	1.18 ** (0.53)	-0.29 *** (0.10)	-1.47 (0.92)	-0.16 *** (0.04)	12.43 *** (0.15)	-2.26 ** (0.91)
Always year-round	0.78 (0.48)	-0.16 * (0.09)	-2.51 *** (0.85)	-0.10 *** (0.04)	0.03 (0.14)	0.50 (0.83)
Transition year-round to casual	0.51 (0.69)	-0.00 (0.13)	-0.84 (1.25)	-0.08 (0.06)	-0.47 ** (0.20)	1.85 (1.20)
Exit from year-round	-0.24 (0.90)	0.28 (0.17)	-3.40 ** (1.63)	0.01 (0.07)	-12.42 *** (0.26)	2.18 (1.56)
Age HH head	0.03 * (0.02)	-0.00 (0.00)			0.01 * (0.01)	0.02 (0.03)
Female HH head <sup>A</sup>	-0.45 (0.78)	-0.13 (0.15)			0.32 (0.23)	-2.18 (1.36)
Household head married <sup>A</sup>	-1.05 (0.83)	0.17 (0.16)			-0.04 (0.24)	-1.38 (1.44)
Household head finished primary education <sup>A</sup>	0.32 (0.47)	-0.00 (0.09)			0.01 (0.14)	-0.97 (0.82)
Household head finished secondary education <sup>A</sup>	-0.07 (0.67)	0.16 (0.13)			-0.02 (0.19)	-1.13 (1.17)
Number of working age members	-0.05 (0.08)	-0.00 (0.01)			-0.02 (0.02)	0.02 (0.13)
Number of dependent members	-0.06 (0.06)	0.02 (0.01)			-0.03 * (0.02)	-0.07 (0.10)
Share literate working age members	-0.34 (0.52)	0.06 (0.10)			0.03 (0.15)	0.76 (0.90)
Total land	-0.02 (0.02)	0.00 (0.00)			0.01 (0.01)	-0.05 (0.04)
Tropical livestock units	0.00 (0.00)	-0.00 (0.00)			-0.00 (0.00)	0.01 * (0.01)
Distance to concrete road	0.04 (0.08)	0.01 (0.02)			-0.02 (0.02)	-0.01 (0.15)
Horticultural export company close <sup>A</sup>	0.27 (0.58)	-0.15 (0.11)			-0.12 (0.17)	1.93 * (1.01)
Constant	-0.65 ** (0.31)	0.12 * (0.06)	2.26 *** (0.53)	0.09 *** (0.02)	-0.01 (0.09)	-0.06 (0.54)
R <sup>2</sup>	0.05	0.08	0.03	0.07	0.98	0.07
N	461	461	461	461	461	461

<sup>A</sup> Dummy variables. Significant effects are indicated with \* p < 0.1. \*\* p < 0.05 or \*\*\* p < 0.01. Standard errors are reported between parentheses.